QUANTITATIVE PORTFOLIO STRATEGY

Hedging Treasury Portfolios with Options on Treasury Futures: An Empirical Study

For investors who wish to shield their portfolios against the possibility of rapidly rising rates, what is the most cost-effective hedging strategy? We investigate strategies using futures and options and compare their performance historically. Due to the cost of hedging, it is not efficient to maintain such hedges over the long term; they are effective only when timed skillfully. We study the cost-effectiveness of these strategies and its dependence on the level of skill.

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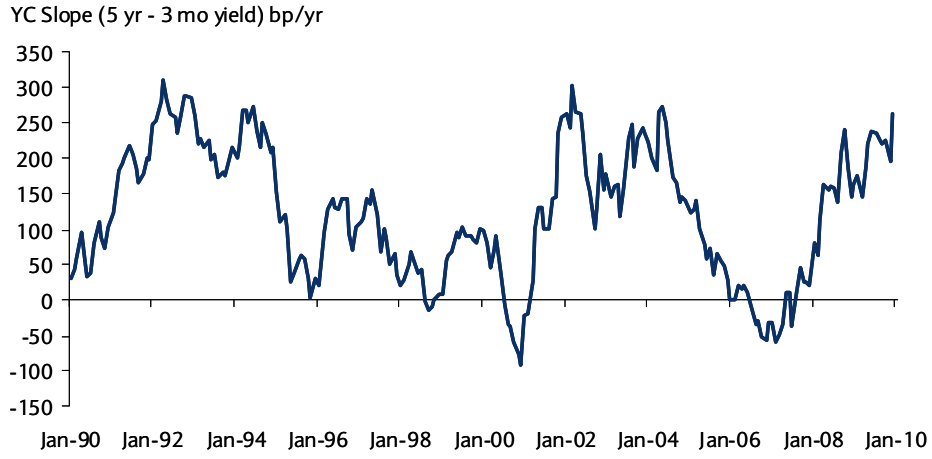
Managing Yield Curve Risk

The recent credit crisis saw an aggressive easing by the Fed, cutting the Fed target rate to nearly zero. With investors moving to high quality government debt from riskier assets, Treasury yields have decreased. Still, markets have since recovered to some extent, and many investors expect the Fed to tighten at some point in the coming year or two to keep inflation in check. Correspondingly, portfolio managers are concerned about their duration exposure and look to shorten their portfolio duration ahead of the anticipated Fed tightening. However, it is not at all clear exactly when this scenario might play out, and maintaining a short-duration position in the current steep yield curve environment can be rather costly. We examine several different approaches to hedging duration and weigh the trade-off between the costs and benefits.

A manager who wishes to shorten a portfolio's duration can do so in a number of ways. A typical method is to overweight the short-duration part of the portfolio and underweight the long-duration part. This can be implemented in either a cash neutral way (by shifting assets from the long to the short duration portion of the portfolio) or by de-leveraging (ie, selling bonds and leaving the proceeds in cash). The duration view can also be implemented using Treasury futures, with a (short) futures position layered on top of the bond portfolio.

While these strategies effectively shorten the portfolio's duration, they entail a loss of carry, assuming a positively sloped yield curve. Figure 1 plots the difference between the 5y and 3m yields historically since January 1990. The yield curve has been generally positively sloped, and the difference in 5y and 3m yields is currently more than 200bp/year. The manager will therefore have to sacrifice this carry in order to implement a short duration view using the strategies mentioned above.

Figure 1: Yield Curve Slope, January 1990 – December 2009



Source: Barclays Capital

In addition to the duration positioning and carry considerations, we also need to consider the possibility of yield curve reshaping. Strategies that involve shifting assets from one part of the curve to another take on exposures to changes in slope. Unintentional exposures to this additional source of risk can hinder portfolio performance, especially given the historical

correlation between yield curve level and slope[1]. In the motivating scenario discussed above, for example, a Fed tightening at the short end might well result in a flattening of the curve from the high current level shown in Figure 1. In this case, the precise implementation of the duration shortening will have a major effect on its performance.

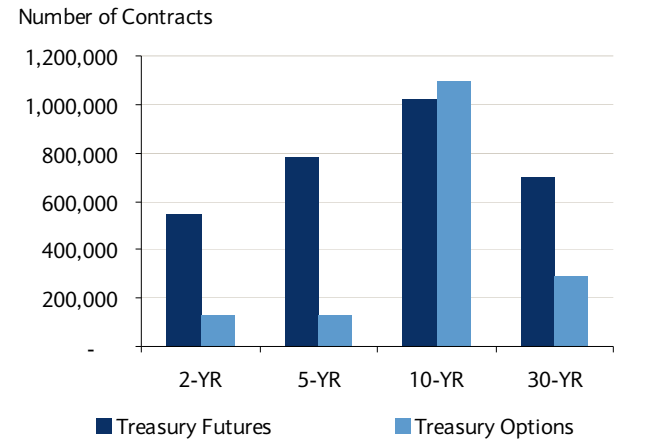
Another way to protect a portfolio from a sudden rise in rates is by using options. While option-based hedges may be structured in a variety of ways, we consider two simple strategies using options on Treasury futures – buying out of the money puts, and using a collar trade (ie, financing purchase of the puts by selling out of the money calls). Unlike the futures hedge, the purchase of out-of-the money options does not immediately affect the portfolio's duration, and the portfolio continues to be exposed to fluctuations in rates. The options serve only to limit the loss that the portfolio may suffer in an extreme rate backup (and, in the case of the collar, to limit the gains in a large rally.) This attractive payoff function – hedging the portfolio against large losses, while continuing to participate in gains – can come at a considerable cost in the form of option premiums. The collar structure arranges downside protection without any upfront cost, but sacrifices some of the upside potential in exchange.

Liquidity Considerations

US Treasury futures are very liquid. For most portfolios, it should be possible to adjust the yield curve exposures as desired using futures; the benefits that duration hedging will bring in a tightening need to be judged against the carry that will be sacrificed in the current steep yield curve environment and the risk of underperforming in a further rates rally. For the options hedge, liquidity is more likely to become an issue. As shown in Figure 2, options on the 10y futures contract are by far the most liquid[2]. For this reason, we focus on option strategies that hedge using 10y options; to provide the fairest comparison between futures and options strategies, we generally use 10y futures as well.

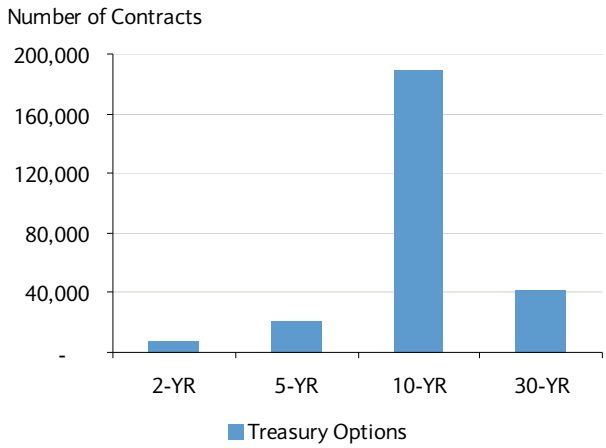
Figure 2: Open Interest and Average Daily Volume for Treasury Futures and Options, as of June 30, 2009

a) Open Interest



Source: CME Group

b) Average Daily Volume



Source: CME Group

[1] For a detailed analysis of this effect, see our recently reprinted article, *Cost of the No-Leverage Constraint in Duration Timing*, Barclays Capital, December 29, 2009. It shows that using futures to implement duration views in a curve-neutral manner can be more efficient than shifting assets between maturity cells.

For very large portfolios, the liquidity and market depth for options on Treasury futures may not be sufficient even at the 10y point. In this case, the hedge may be implemented with swaptions instead. The greater depth of the swaptions market would allow the strategy to be carried out in much larger size, but the swaption position would have an unintended exposure to swap spreads, which have been very volatile in the recent past. We do not explore a swaptions-based hedging strategy here and only consider Treasury futures and options for hedging Treasury yields.

Data

The study uses the Barclays Capital US Treasury Intermediate Index as the portfolio we wish to hedge. End-of-month mid-market prices for 10y US Treasury note futures and options (puts and calls) are used, for which we have data since January 2001. Both serial expiration and quarterly expiration contract months are considered for the options, depending on how frequently we rebalance our hedges.

Monthly Hedging of Treasury Portfolios

We initially hedge the Treasury index on a monthly frequency, using serial expiration contract months for the options. We consider two choices for the option-based hedge – buying out-of-the-money puts on the 10y note future and constructing a self-financing collar by simultaneously buying puts and selling out-of-the-money calls. We then compare these option overlays to hedging using 10y futures.

Hedging – Implementation Details

We rebalance the hedges on a monthly basis as of the close on the last business day of the month. The hedges are never adjusted intra-month. Therefore, option contracts are not held till expiry, and are instead transacted at month end before they expire. More details are as follows:

- ***Contract Month:*** The option month is chosen such that it is the nearest to expiry out of all the contracts that do not have their last trading day within the month. Serial options exercise into the first nearby quarterly futures contract, with their last trading day being the last Friday, which precedes by at least two business days the last business day of the month preceding the option expiration month[3]. For example, the 2009 November ("X") option is last traded on October 23, 2009. We would thus choose this option for the full calendar month of September 2009, but not for October. On September 30, we sell our position in the November puts, and buy December puts to hedge during the month of October. It should be noted that the November puts are not held until October 23 since we assume that the hedges are never adjusted intra-month. When hedging using 10y futures, we use the standard quarterly contracts, and use the same contract as for the options.
- ***Option Strike:*** The effectiveness (and the cost) of the option-based hedge is heavily dependent on the option strike chosen. In this study, we hedge against a large (> 1 std. deviation) increase in Treasury yields. Historical volatility of the 10y yield from January 1990 to December 2000 (prior to January 2001, when we start the study) was 26bp/month, and a 1 std. deviation increase in 10y yields is approximately equal to a 2

[2] Roundtrip cost as measured by the bid-ask spread is fairly small for the 10y option contract. As of the time of writing, bid-ask spreads are fairly tight at about 2/64th for these options, and liquidity is such that it should be possible to execute at least one or two thousand contracts (ie, $100-200mn notional) at these tight spreads.
[3] For more information on US Treasury futures and options, please refer to the CME website (www.cmegroup.com)

point decrease in price. We therefore implement the hedge with options that are 2 points out of the money as of month end.[4]

- ***Number of Contracts:*** How many futures and option contracts should we buy for the hedge? When hedging with 10y note futures, the hedge ratio is based on matching dollar durations of the Treasury portfolio and the 10y futures contract, as given below (with a negative sign on the number of contracts denoting a short position).

$$N_{futures} = \frac{-MV_{portfolio}}{\frac{D_{futures}}{D_{portfolio}} \times \frac{P_{futures}}{100} \times C_{futures}}$$

Here, N is the number of contracts, D is the (beginning-of-month) duration, P is the (beginning-of-month) price, MV is the (beginning-of-month) market value, and C is the contract size. So, for example, to hedge a USD 1bn portfolio with a duration of 4, we would need to short 4,000 10y futures contracts (with a contract size of $100,000, and assuming a price of 125 and duration of 8 for the 10y future).

For the strategy of buying put options, we use out-of-the-money strikes to minimize the upfront cost of purchasing protection. This is not designed to protect the portfolio from small fluctuations in rates from current levels, but to limit losses in the case of a large increase in rates. Therefore, the number of put contracts purchased is the same as the number of futures contracts we would short if hedging with futures as described above:

$$N_{put} = -N_{futures}.$$

The sizing of the option position thus does not depend on the option delta and does not need to be adjusted during the course of the month. If rates rise sufficiently, the delta of the option will approach -1, and the options will protect against further rate increases just as well as the futures.

For the collar trade, the number of calls sold is such that the collar is self-financing, as given below[5]. Since the calls, like the puts, are two points out of the money, their prices should be similar, and hence the number of calls sold in the collar is approximately the same as the number of puts purchased.

$$N_{call} = \frac{-N_{put} \times P_{put}}{P_{call}}$$

Finally, it should be noted that all three hedging strategies are exposed to non-parallel changes (twist/butterfly) in the yield curve because of a mismatch in key rate durations between the portfolio and the futures contract. We could have potentially minimized the mismatch by including other tenors (2y, 5y, and long bond contracts), but we do not use options other than on the 10y future because of the limited open interests on these contracts.

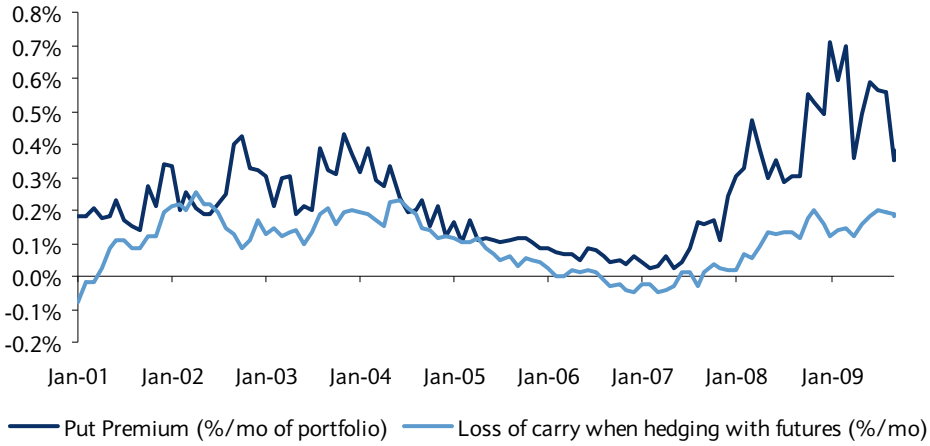
Hedging – Cost of Implementing Hedge

What is the cost of hedging using the three methods – buying puts, shorting futures, and trading collars? Figure 3 plots the historical premium for the puts (as %/month of portfolio market

[4] For example, if the 10y note futures contract is at 117-00 on month end, we buy puts with strike price set at 115. There are some months when we do not have data on options that are 2 points out of the money. In this case, we hedge with options that are 2.5 points away from the ATM strike.
[5] We round the number of calls to the nearest integer and ignore the issue of odd lots.

value) from January 2001 to October 2009. On average, the up-front cost of hedging with puts is 24bp/month. The cost varies over time and was particularly high during the recent crisis.[6]

Figure 3: Up-front cost of hedging with puts and with futures (Jan-01 to Oct-09)



Source: Barclays Capital

When hedging with futures (or selling the entire portfolio and staying in cash), the up-front cost is the loss of carry as the portfolio would now earn some short-term rate. Figure 3 plots the portfolio carry, calculated as the difference in the 5y and 3m Treasury yields.[7] On average, portfolio managers invested in the U.S. Treasury Intermediate Index lost 10bp/month in carry when shortening the duration to (nearly) zero.

The costs of hedging with puts or with futures are highly correlated, with a monthly correlation of 61% from January 2001 to October 2009. This seems to imply that steeper yield curves are accompanied by higher rates volatility. The puts cost more up-front relative to futures and have been more expensive recently with the uptick in volatility. But this does not mean that the futures are better as a hedge, in our view – from a pure cost perspective, the collar strategy would look best as it can be implemented at zero cost. However, the upfront cost is not the ultimate measure of a hedging strategy's performance; we need to consider the hedged portfolio's total return. As we shall find, none of the hedged strategies have particularly attractive performance records when applied continuously over long periods of time; the costs of hedging detract too much from the index returns. The decision to hedge in practice would be made selectively based on the manager's view on duration for the month, and the effectiveness of the hedge would depend on the manager's skill in timing duration, which we discuss later in this paper.

Hedging – Historical Performance

Figure 4 summarizes the performance statistics for the three hedging strategies, along with the unhedged Treasury index. We assume that the hedges are consistently applied every month, as a passive overlay, in order to examine the payoffs for these different hedging strategies.

[6] For example, the put premium was $687.5 per $100,000 of notional value for the month of October 2009. Using 5,539 contracts to hedge a $1bn portfolio, the premium paid came to 0.38% of the portfolio market value.
[7] We take the Barclays Capital U.S. Treasury Intermediate Index as the portfolio, which has a duration of about 4. We therefore consider the Treasury index to be earning the 5y yield.

Figure 5: Summary Statistics for Different Hedging Strategies (Jan-01 to Oct-09)

	U.S. Treasury (Intermediate) Index	Hedged with puts every month	Hedged with collar every month	Hedged with 10yr futures every month
Average Return (%/mo)	0.42%	0.35%	0.33%	0.21%
Volatility (%/mo)	1.01%	0.83%	0.57%	0.36%
Best month (%/mo)	3.70%	3.16%	1.97%	1.44%
Worst month (%/mo)	-2.26%	-1.30%	-0.98%	-1.47%

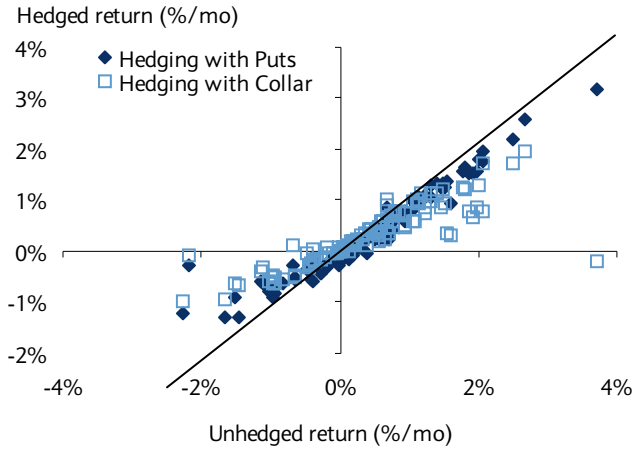
Source: Barclays Capital

Rates have generally declined over the 2001-2009 period, and therefore all the three hedged portfolios have lower average returns than the unhedged index. For the same reason, the put based hedge has higher average returns than either the collar or the futures based hedge (both of which cap the upside when Treasuries rally). Even though the up-front premium for the puts is 24bp/month on average, the put-hedged portfolio underperforms the unhedged index by only 7bp/month. The futures-hedged portfolio has a smaller up-front cost of 10bp/month, but underperforms the index by 21bp/month. Performance for the collar-based hedge is somewhere in between that for the puts and the futures, underperforming the index by 9bp/month. Not surprisingly, futures are the most effective in reducing the overall volatility of the portfolio, and in protecting the portfolio during the worst months of performance[8].

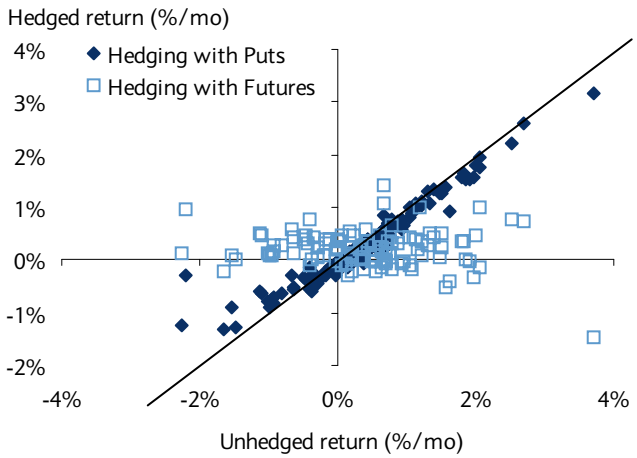
Figure 5 plots the monthly return for the three hedging strategies versus the return for the unhedged Treasury index. In Figure 5, Panel A, the monthly returns for the portfolio hedged with puts mostly lie below the 45 degree line, indicating that the hedged portfolio underperforms the unhedged portfolio in most months due to the cost of the puts. In months with big negative returns for the unhedged portfolio, the puts help to mitigate the loss but are less effective than the collars, and much less so than the futures (in Panel B). But in months when Treasuries rally (right-hand side of the two plots), the futures substantially limit the upside, as does the collar based hedge (to an extent) relative to the puts.

Figure 4: Scatter-plot of monthly returns for hedged versus unhedged index

Panel A: Hedging with Puts and with Collar



Panel B: Hedging with Puts and with Futures



Source: Barclays Capital

[8] The worst month for the futures-hedged portfolio, with a return of -1.47%, actually occurred due to over-hedging during the best performance month for the unhedged index, November 2008. This outcome, which shows up as an outlier in Figure 5B, is partly due to the choice of the 10y futures as the hedging instrument, as discussed below. Figure 5B indeed shows that the futures hedge worked quite well to protect against losses in the unhedged index.

Ideally, one would expect that if futures are used to completely hedge out the duration exposures of the index, the resulting return should essentially be just the risk-free return every month. Such a strategy should never suffer a negative monthly return; yet Figure 5B shows that our futures-hedged implementation has several such months. Similarly, one might expect the volatility of the futures-hedged strategy to be even lower than the 36bp/month shown in Figure 4. One reason that our futures hedge does not meet these expectations is its exposure to changes in the shape of the yield curve. We have limited ourselves to the use of 10y futures, even though we are hedging an index with a duration of only four years. We did this due to the liquidity considerations discussed above. The 10y future is the most liquid contract, by a small amount. More importantly, the 10y was the only contract for which the options market was deemed sufficiently liquid. To ensure a fair comparison between futures and options hedges, it was important to use the same contract for both. In Figure 6, we illustrate the performance that could have been obtained using different implementations of the futures hedge. Hedging with the 5y note contract rather than the 10y note contract gives a significant decrease in the volatility, and in the extreme tails of the returns. Using a combination of three different contracts to match the key rate duration exposures of the index can further improve the hedge, by both these measures[9]. For investors who choose to implement such hedging solely with futures, the choice of contracts to use should be carefully matched to the term structure exposures of the portfolio to be hedged.

Figure 6: Summary Statistics for Different Hedging Strategies Using Futures (Jan-01 to Oct-09)

			Index hedged with futures			
	3 mo T-bill yield	Unhedged Index	2y futures	5yr futures	10yr futures	Combination of 2, 5,10y futures
Average (%/mo)	0.21%	0.42%	0.13%	0.16%	0.21%	0.17%
Volatility (%/mo)	0.14%	1.01%	0.39%	0.28%	0.36%	0.23%
Worst Month	0.00%	-2.26%	-1.07%	-0.78%	-1.47%	-0.63%
Best Month	0.49%	3.70%	0.94%	0.76%	1.44%	0.57%

Source: Barclays Capital

Skill-based Simulation of Hedging Strategies

As shown in Figure 5, futures are most effective in hedging against rising yields, but also negate any upside in case yields decline for the month. The hedging strategy to use therefore finally depends on the skill of the portfolio manager in timing duration. With a "perfect" duration signal, the futures-based hedge would outperform the option-based hedges. But the penalty for being wrong would be higher when hedging with futures.

In order to quantitatively analyse the performance of these hedges for different manager skill levels, we simulate the three hedging strategies using an "imperfect foresight" approach[10]. Each month, the simulated manager makes a call on duration (neutral or short) as compared to holding the Barclays Capital U.S. Treasury Intermediate Index. The neutral duration view is expressed by keeping the Treasury index unhedged, while the short one is expressed by hedging the Treasury portfolio for the month using puts, collars or futures.

[9] Note that while better matching of yield curve exposures can reduce risk, the futures replication error cannot be reduced to zero. The hedged portfolios all have occasional months with negative returns, and volatilities are larger than those of cash returns. This is due to the basis risk of the futures contracts.
[10] For more details on the imperfect foresight approach, refer to "Value of Security Selection versus Asset Allocation in Credit Markets: Part II – An "Imperfect Foresight" Study, Lehman Brothers, June 2000.

Note that the view on duration (relative to the index) is limited to a binary decision, and we disregard the possibility of either taking an ultra-short duration view by over-hedging or taking a long duration view by leveraging the Treasury index.

We simulate the performance of the different hedges using historical data from January 2001 – October 2009, and use Sharpe Ratios to evaluate performance[11]. Each month, the manager makes a decision on whether to hedge or not, and a probability is assigned to the two choices based on manager skill. The "correct" decision for the month is to hedge whenever the unhedged returns for the Intermediate Treasury Index are (ex-post) negative. We explore performance at manager skill levels ranging from 0% (random selection) to 100% (perfect foresight). In the unskilled case (0% skill), the manager randomly selects whether to hedge or not, with equal probabilities of the two choices. In the perfect foresight case (100% skill), the manager always chooses the correct decision. For skill levels between 0% and 100%, the selection probabilities for the two choices (i.e., hedged or unhedged) are linearly interpolated between these two extremes.

Figure 7 tabulates and plots the Sharpe Ratio of the portfolio for the three hedging schemes, for different levels of manager skill. The Sharpe Ratio of the unhedged index is plotted as well, for comparison.

There are three points to take away from Figure 7. One, for very high levels of skill (>20%), a futures-based hedge is more effective than hedging with either puts or collars. Two, the collar-based hedge always outperforms hedging with puts, for any level of skill. While the collar-hedged portfolio has lower returns than the put-hedged portfolio for very low skill, the risk-adjusted returns are always higher due to a greater reduction in volatility.[12] And three, for low levels of skill (less than 10%), the unhedged Treasury index performs better than any hedging strategy. The collar-hedged portfolio outperforms the unhedged Treasury index only for skill levels of 10% or more (with a Sharpe Ratio of 0.71 for the collar-based hedged portfolio at 10% skill, compared to 0.63 for the unhedged portfolio).

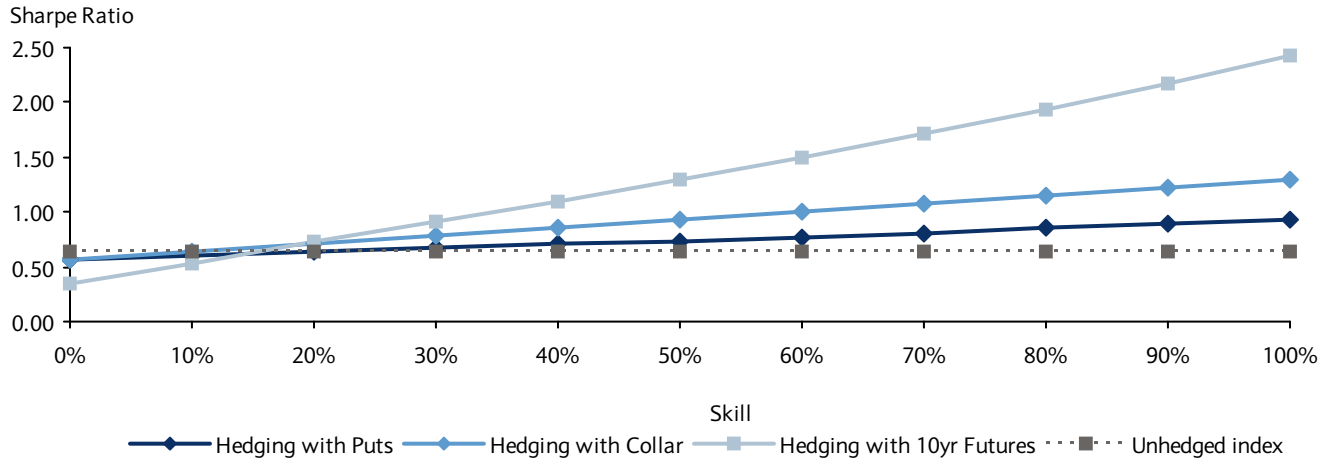
It should be noted that these results are based on data from January 2001 to October 2009, and may not be representative of other interest rate regimes. Still, the results of the analysis gel with our intuition regarding the effectiveness of the three hedging strategies. The futures-based hedge is the most effective at very high levels of skill, but with a skill of 20% and higher being difficult to achieve, collars seem to provide the best hedge. Moreover, it does not pay to hedge at low levels of skill. At these low levels, the costs of implementing the hedge as well as the losses incurred by the hedges exceed any benefit that the hedges may provide in months when yields do increase substantially.

[11] Outperformance of the portfolio is measured against cash (which we take as investment in 1m USD Libor)

[12] When comparing the performance of strategies with asymmetric return distributions options, volatility and information ratio are not the best performance metrics. Not all volatility is bad, and if the collar strategy reduces volatility by capping returns on the upside, this should not be considered an advantage. It would be preferable to use a measure of downside risk, such as semideviation, or standard deviation of negative returns, and compare strategies based on a measure like the Sortino ratio, which rescales the expected returns by semideviation. Our imperfect foresight framework makes this measurement somewhat difficult. Nevertheless, Figure 7 shows that the difference in volatility is not the key driver of the performance difference between these strategies. if we assume that the downside risk of the put and collar strategies is similar, we would find that even in these terms, the collar hedge outperforms the puts as soon as skill becomes sufficiently positive, mainly due to the reduction in upfront cost when hedging.

Figure 7: Portfolio Performance as a Function of Skill for Different Hedging Schemes

	Hedging with Puts			Hedging with Collar			Hedging with 10yr Futures		
Skill Level	Mean Ret (ann, over cash)	Vol (ann, over cash)	Sharpe Ratio	Mean Ret (ann, over cash)	Vol (ann, over cash)	Sharpe Ratio	Mean Ret (ann, over cash)	Vol (ann, over cash)	Sharpe Ratio
0%	1.76	3.15	0.56	1.60	2.80	0.57	0.91	2.59	0.35
10%	1.87	3.15	0.59	1.81	2.81	0.64	1.40	2.60	0.54
20%	1.98	3.15	0.63	2.02	2.82	0.71	1.88	2.61	0.72
30%	2.10	3.15	0.67	2.23	2.83	0.79	2.36	2.60	0.91
40%	2.21	3.14	0.70	2.44	2.84	0.86	2.85	2.59	1.10
50%	2.32	3.14	0.74	2.65	2.85	0.93	3.33	2.57	1.29
60%	2.43	3.14	0.78	2.86	2.86	1.00	3.81	2.55	1.50
70%	2.54	3.13	0.81	3.07	2.86	1.07	4.30	2.51	1.71
80%	2.66	3.13	0.85	3.28	2.87	1.14	4.78	2.47	1.93
90%	2.77	3.12	0.89	3.49	2.87	1.22	5.26	2.42	2.17
100%	2.88	3.12	0.92	3.70	2.87	1.29	5.75	2.36	2.43



Source: Barclays Capital

Quarterly Hedging of Treasury Portfolios

A monthly rebalanced hedge allows for enough data to conduct an imperfect foresight study and quantitatively compare the effectiveness of the hedges for different levels of skill. Portfolio managers may also want to rebalance their hedges monthly during periods of higher uncertainty in the markets. Still, many managers take a longer view on duration, and would prefer to put on a hedge over longer periods. We therefore further analyze the performance of implementing the hedges on a quarterly frequency.

The implementation of the quarterly hedge is fairly similar to that for the monthly frequency. To reflect the difference in view horizon, we introduce two changes. The option-based hedges use quarterly option contracts instead of the serial monthly contracts, and the strikes are set 3.5 points out of the money, instead of 2 points out of the money for the monthly hedging. As before, the option strike is chosen so as to hedge against large

increase in yields (more than 1 standard deviation historically)[13]; the longer horizon makes larger yield changes more likely. The hedges (options or futures) are applied every three months for the Feb-Apr, May-Jul, Aug-Oct, and Nov-Jan quarterly cycle[14].

Historical Performance

Figure 8 summarizes the performance statistics for the three quarterly hedged portfolios, as well as the unhedged Treasury index, from February 2001 to October 2009.

Figure 8: Summary Statistics for Quarterly Hedging Strategies (Feb-01 to Oct-09)

	U.S. Treasury (Intermediate) Index	Quarterly Hedged with puts	Quarterly Hedged with collar	Quarterly Hedged with 10y futures
Average Return (%/qtr)	1.25%	1.03%	0.99%	0.63%
Volatility (%/qtr)	1.60%	1.56%	1.13%	0.80%
Best quarter (%/qtr)	5.48%	5.37%	4.00%	2.54%
Worst quarter (%/qtr)	-1.27%	-0.96%	-0.60%	-1.81%

Source: Barclays Capital

As with the monthly hedging, the unhedged index has higher average returns than any of the three hedged portfolios. The futures hedge leads to significantly lower returns (0.63%/qtr compared with 1.25%/qtr for the unhedged portfolio) but cuts the volatility of the portfolio nearly in half.

It is worth noting that when the hedges are applied continuously, it makes very little difference whether we hedge on a quarterly or monthly frequency. Comparing the performance statistics in Figure 4 (for the monthly hedges) and Figure 8 (for the quarterly hedges), the average return is similar for each hedging scheme, whether hedged monthly or quarterly, while the return volatility is slightly higher for the quarterly hedge[15]. The quarterly put contracts have a lower up-front cost (31bp/qtr for the put premium) when compared to the monthly contracts (24bp/month). This lower cost is due to the fact that we use quarterly options further out of the money and pay additional transaction costs when rebalancing every month. However, the quarterly put-hedged portfolio underperforms the Treasury index by 22bp/quarter, similar to the 7bp/month underperformance when hedging monthly. Note also hedging quarterly and using further out-of-the-money puts allows us to reduce the upfront cost for the puts to 10bp/month, similar to the carry given up in shortening the portfolio duration to zero.

The decision to hedge either monthly or quarterly therefore rests on the horizon of the duration view. If the portfolio manager has confidence in his duration signal only over the short term, or if the markets are highly volatile, then hedging on a monthly frequency seems to make more sense. Otherwise, hedges could be put on over a longer time period.

[13] Volatility of 10y yields from 1990-2000 is 26bp/month, or equivalently, 45bp/quarter. A 1 standard deviation move in yields is approximately equal to a 3.5% change in price

[14] Note that the hedging is not on the Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec quarterly cycle. This is because the hedging period is dependent on the option contract available for those three months. For the quarterly hedging, Nov-Jan months use the Mar ('H') contract, Feb-Apr months use the Jun ('M') contract, and so on.

[15] In fact some of the difference can be explained by the fact that the quarterly hedging starts February 2001, while the monthly hedging in Figure 3 is from January 2001.

Other Scenarios

Throughout this article, we have adopted a consensus view that interest rates are expected to head higher, the only question being the timing. Of course, other scenarios can not be ruled out entirely. For example, even if the Fed does indeed start raising short-term rates in 2010, longer-term rates may not follow suit. The steep yield curve is already pricing in this expectation of rising short rates, and one possible dynamic is that the Fed action could simply cause the curve to flatten. This would roughly parallel the experience of the previous tightening cycle in 2006. Investors who believe this scenario to be the most likely may not feel any urgent need to hedge their Treasury exposures and will be happy to reap the term premium from today's steep curve while it lasts. Another scenario in which hedging could be detrimental is the dreaded "double-dip" recession. In the heat of the credit crisis, as all risky assets suffered losses, one of the only true diversifiers of portfolio returns was a healthy exposure to Treasuries. Should the current rally succumb to another wave of risk aversion, exposure to long-term Treasury rates will provide critical support to returns. Investors who hedge away all of their interest rate exposure with futures might come to regret this decision. Those who wish to protect against both a rise in rates and this "double-dip" scenario may prefer to hedge with options. This approach, while it is most expensive, does not sacrifice the upside potential of Treasuries.

For investors who are convinced that long-term Treasury yields will soon head higher, the question of timing still poses a tricky dilemma. Just as the steep yield curve and the market consensus have convinced us that hedging is required, it has also made the cost of hedging much higher. The yield give-up for shortening duration is near its historical peak, and options volatility is high as well. The long-term study in this article quantifies the long-term average cost of different hedges, but the monthly cost of maintaining these hedges in the current environment is much higher than average. This sharpens the need for skill in timing the hedge. The risk of remaining unhedged means that most investors would prefer to be early by a few months than to be late by a week; but carrying such hedges for an extra year may cost more than the rise in rates that we are trying to protect against.

Conclusion

We empirically analyze shortening duration with options on Treasury futures by buying out-of-the-money puts or trading collars, and compare it with hedging with 10y futures. We also conduct an imperfect foresight study to estimate the level of skill required in timing duration for these hedges to be cost-effective.

Performances of the hedging strategies were fairly similar, whether the hedges were rebalanced on a monthly or a quarterly frequency. With monthly hedging, the up-front cost for the puts is higher, on average, than the loss of carry when shorting futures. However, the futures-based hedge negates any gain when Treasuries rally and therefore performed poorly compared with the option-based hedge at low levels of skill. In fact, at very low levels of skill (< 10%), it did not pay to hedge at all during the January 2001 to October 2009 period, with the unhedged Treasury portfolio having a higher risk-adjusted return than the hedged portfolios. The collar-based hedge performed best at intermediate skill levels (between 10% and 20%) and had higher risk adjusted returns than the put-based hedge.

Analyst Certification(s)

We, Madhur Ambastha and Jay Hyman, hereby certify (1) that the views expressed in this research report accurately reflect our personal views about any or all of the subject securities or issuers referred to in this research report and (2) no part of our compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this research report.

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