Tax Loss Harvesting: A Framework for Optimal Timing

Dr. Leonid Kogan
Dr. Vinay Nair[1]
July 2017

[1] L. Kogan is Chief Investment Scientist at 55 Institutional Partners and a Professor of Finance at the MIT Sloan School of Management. V. Nair is the founder and Chairman of 55 Institutional, and a visiting professor at MIT Sloan School of Management and The Wharton School at the University of Pennsylvania.

Contents

The Rationale for Harvesting Unrealized Losses

Tax optimization is a central feature of portfolio management for taxable accounts. The core of the tax optimization process is to be conscious of how pre-tax returns are split between short-term realized returns and long-term unrealized returns, since these two components are taxed at different rates. Tax optimization attempts to manage the portfolio and its trading to minimize the short-term realized gains while maximizing the longer term unrealized gains. One of the main techniques used to do this is to "harvest" unrealized short-term losses. This is achieved by selling such positions and converting them to realized short-term losses thus decreasing the short-term capital gains.

The Importance of Timing

Timing is an important aspect in evaluating the decision to harvest short term losses. The decision of when to harvest losses must account for several inputs. While the benefits of tax loss harvesting are better understood, there are several costs. An investor that harvests any unrealized tax loss incurs transaction costs associated with the trading, as well as be subject to tracking error due to imperfect substitution positions. Further, since wash-sales restrictions prohibit the purchase of the initial position for a 30-day period, they would be leaving behind the option to wait and harvest possibly higher losses in the future.[2] As a result, an optimal solution that is practical should harvest only after losses reach a certain threshold rather than at the first possible opportunity. The problem is however not straightforward and most financial advisors simply end up using a constant trigger, typically a 5% loss level, for all positions. In this note, we explore the key determinants of the tax harvesting strategy and provide guidance on the framework used by the tax technology at 55 Institutional.

TRADING COSTS

To harvest losses, the investor must trade out of the primary position to the substitute, and potentially return to the primary in the future. This round-trip creates direct and indirect trading costs. Higher trading costs reduce the benefits of tax loss harvesting. Hence everything else equal higher costs imply more conservative harvesting policies.

VOLATILITY

Volatility has two related implications. First, higher volatility may provide more attractive opportunities to harvest losses in the future. Second, if an advisor returns to the original

[2] Some legalese here that is important: the IRS defines a wash sale as one that occurs when an individual sells or trades a security at a loss, and within 30 days before or after this sale, buys a "substantially identical" stock or security, or acquires a contract or option to do so.

position once allowed by the wash sales rules, as is typically the case, higher volatility may also decrease the likelihood of tax benefits after the roundtrip. The latter merits some comment. If the value of the substitute basket rises sufficiently during the period when wash sales restrictions apply, one runs the risk of realizing a net gain at the end of the roundtrip. To reduce the likelihood of such negative outcomes, one should adopt a more conservative harvesting threshold. As a result, everything else equal, higher volatility of the original position implies a more conservative loss harvesting strategy.

TRACKING ERROR

When a position is replaced by a substitute position, the portfolio is subject to a tracking error. The tracking error can hurt pre-tax returns even as the investor harvests losses. The greater the volatility of the tracking error, greater are the chances of such adverse deviations. As a result, higher volatility of the tracking error gives rise to a more conservative harvesting threshold.

TAX RATES

The benefit of tax harvesting is driven by the difference in long term and short-term capital gains tax rates. Thus, the benefit of tax loss harvesting is investor-specific, and depends on the short-term capital gains rate (the marginal income tax rate) as well as the long-term capital gains rate. In addition, the after-tax costs of trading depend directly on the short-term capital gains rate.

CALENDAR

Current calendar time is naturally relevant for loss harvesting decisions. First, it is desirable to harvest losses before the end of the calendar year. Second, the age of the original position determines its tax treatment, and thus the benefits of harvesting.

TURNOVER

The turnover rate of the portfolio affects harvesting decisions. With a low turnover rate, one is relatively free to time the harvesting decision based on the above considerations. Higher turnover reduces one's ability to convert short-term gains into long-term gains, thus reducing the benefits of loss harvesting.

The Framework to Determine Loss Thresholds

Most current systems for tax optimization fail to account for these inputs in a satisfying manner. To address this, 55 Institutional has created a framework that uses a few core concepts.

There is an inherent option embedded in the tax harvesting problem: rather than harvesting losses today, an investor can wait and revisit the decision later. The tradeoff is that one harvests losses at that time and captures the opportunity or waits for a future and a likely better opportunity. One cannot do both because of the wash-sale rule. This option is akin

to the option to wait, which commonly arises in dynamic investment problems, although the specific nature of the tax rules complicates the problem. An investor can harvest taxes multiple times, provided the policy respects the wash sales restrictions. Thus, we are dealing with a compound option problem, where the harvesting decisions leaves the investor with an immediate payoff and an option to harvest again after the expiration of the wash sales restriction.[3] We solve this problem numerically by first evaluating the solution at year end, and then dynamically at earlier dates.

In addition to the wash-sale rule, the option to wait arises because trading is costly. Tight loss harvesting thresholds imply more frequent harvesting and higher cumulative trading costs. Waiting helps economize on the cost, while trading the immediate benefit of harvesting against the potential future benefit.

Our framework also uses two additional features from robust control and from behavioral finance. We incorporate the cost of imperfect substitution when a position is harvested by using the robust control framework to reflect the uncertainty around how closely the substitute basket will mimic the original position. The robust control framework ensures that higher tracking error substitutions require a deeper loss. The robust control approach considers an adverse realization of the tracking error in calculating the loss threshold.

We also incorporate the presence of an investor with a bird-in-hand preference to choose different levels of urgency in capturing the tax losses. An investor who behaviorally values today's bird-in-hand over the ones in the bush would be more aggressive in their tax loss harvesting actions.

Finally, in computing optimal loss thresholds, we use the substitution baskets derived from the 55 Approach. The industry standard to harvest losses on a given ETF is to choose another ETF with the same dollar amount. For example, a leading robo-advisor in their tax harvesting white paper replaces XLE with VDE. This approach leads to high tracking error - the correlation between XLE and VDE, for example, is only 73%.

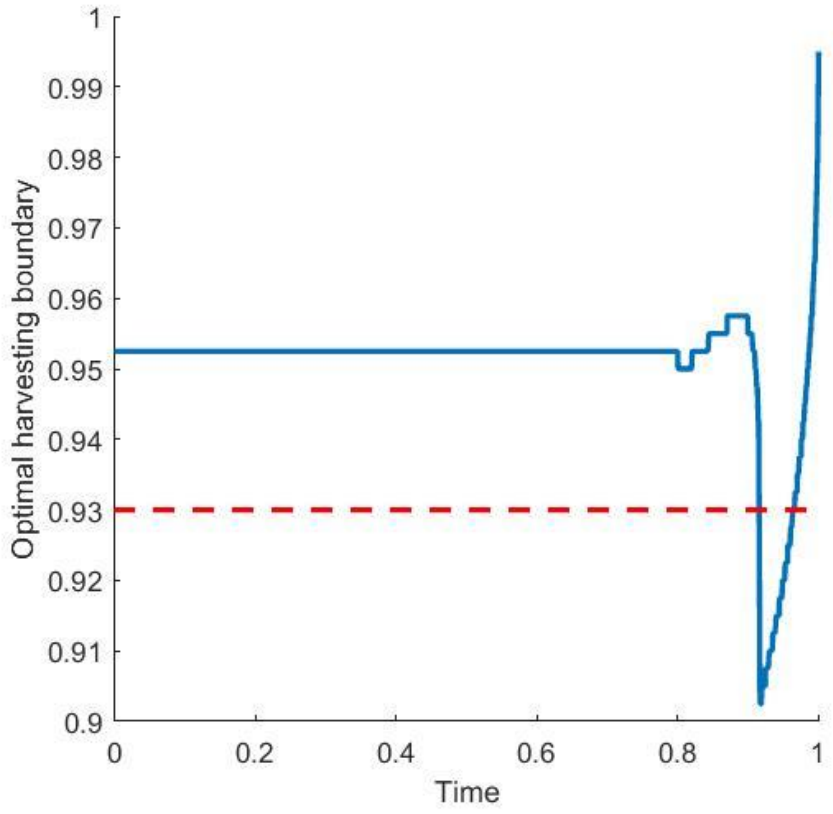
Our approach allows the substitution of a position by a portfolio of positions when its replicating properties are superior. Initially, we select a handful of liquid ETFs that are fundamentally related to the ETF considered. Then we use a proprietary machine learning based algorithm to dynamically select proxy baskets. This enables proxy selection that optimizes substitution error and is dynamic. As result, the 55 Institutional proxy baskets decrease the tracking error.

While we have been able to approximate the resulting solution with a closed form formula for discussions in the paper, the accurate results are numerically derived. These results are instructive.

[3] In theory, it is possible to replace the proxy with the proxy's proxy within the wash sales period. This will typically increase tracking error but is possible in some cases. For simplicity, we assume that tax loss harvesting is done only at one level of substitution.

The General Shape of the Optimal Loss Thresholds

The blue line in the graph below provides a general shape of how the threshold varies over time.



As an illustration, the graph above uses a position with an annualized volatility of 17% and a substitution basket with a tracking error of 1%. Suppose that the round-trip transaction costs are 0.05%, and the short-term and the long-term tax rates are 43.4% and 23.8%, respectively. Consider a position established on May 1st. On October 1st, the loss threshold for harvesting this position is ~6%, i.e., one should realize short-term losses provided they exceed 6% in magnitude. In contrast, on December 2nd, the loss threshold is ~10%. The reason for more aggressive harvesting in October is that after trading the position on October 1st, one will have further opportunities to realize losses in November and December, while the position traded on December 2nd cannot be traded further until the

end of the year due to wash sales constraints. On December 22nd, the threshold is ~4%. As the end of the year approaches, the option to wait becomes less valuable, and tax harvesting becomes more aggressive. The red line represents an approximate closed form formula that is consistent over time and is used below to highlight deviations from rebalancing practices that are prevalent in the industry.

The Magnitude of The Optimal Loss Thresholds

Many investors and advisors often use a fixed threshold for all positions. This is often -5%. Our results highlight that this simplistic heuristic may result in significant deviations from what is optimal. Using three levels of the bird-in-hand preference to compute thresholds for the top 100 ETFs, we find that the moderate scenario (closest to the -5% heuristic) can result in thresholds that are as low as -0.17% and as high as -14.6%. Numbers for all scenarios are presented below.

	Aggressive	**Moderate**	**Conservative**
Median	1.11%	4.69%	7.34%
Max	6.39%	14.61%	22.46%
Min	0.17%	0.17%	0.17%

BETTER SUBSTITUTION PROVIDES MORE OPPORTUNITIES

We also find that replacing 55 substitute baskets with naïve proxies (most correlated ETF), or with cash has a material impact on the loss thresholds. This is particularly notable in positions with higher volatility and higher tracking errors. For example, the maximum threshold in the table increases from 6.39% to 21.06% when we replace 55 substitution basket with the most correlated ETF substitute! The direct implication of this is that 55 substitute baskets not only decrease the tracking error but also allow greater tax loss harvesting.

Aggressive	**Naïve**	**Basket**
Median	1.26%	1.11%
Max	21.06%	6.39%

Min	0.25%	0.17%

The Benefits to A Simple Portfolio

Below, we contrast two simple approaches with different rules to harvest tax losses. In the first, the loss threshold is -5%, and the substitution is done with the ETF that is most closely correlated. In the second, we use thresholds derived from the framework described above and 55 substitution baskets. These two rules are applied to a portfolio of sector ETFs used to provide broad based exposure to S&P 500 Index. The table below highlights the value added by the 55 Approach.

SPY **2007-2016**		
	55 Threshold	5% Threshold
Calendar Year Average Returns Pre-Tax	9.22%	9.02%
Calendar Year Average Returns Post-Tax	11.25%	10.91%
55 Tax Savings (Difference in Post-Tax Returns)	2.53%	2.19%

Since 2007, 55 thresholds increase tax savings and adds 34 bps of annual tax savings versus the 5% threshold. While these gains are material, they also don't fully reflect the latent potential in the 55 Approach. As seen from the analysis of the loss thresholds in earlier sections, the benefits are most prominent when positions are more volatile. As a result, portfolios that are more volatile, multi-asset or granular will see the biggest marginal benefits. This also allows the technology to now be applied in areas where tax management was difficult to execute.

Conclusion:

Tax management of investment strategies relies on harvesting unrealized losses to decrease short term gains. The level of loss at which one should harvest the loss is an important decision in this process. This decision should account for a broad set of factors including substitution errors, behavioral preferences, tax rates, trading costs, and return distributions among others. We provide a framework using option theory with features from robust control and behavioral finance. The solutions show material deviations from typical heuristics used in the industry. This improvement translates into material improvement in post-tax returns for tax aware investors.