Columbine White Paper

The Columbine Alpha Model and Trading Volume: A Review

AUGUST, 2004

SUMMARY

- Technicians have long considered a stock's trading volume as important confirmation of its price changes, but as originally developed, Columbine Alpha price momentum made no use of volume information.
- In 2001, drawing on the work of Lee and Swaminathan, we learned that long-term increases in trading volume reduce the return potential of high positive momentum stocks.
- In 2004 we observed that high recent turnover (trading volume divided by shares outstanding) has an amplifying effect on extreme price momentum. This effect is present with both positive and negative momentum stocks, but is more consistent in negative momentum issues.
- Neither volume-related effect is widespread enough to improve the performance of an entire decile (10%) of high momentum stocks, but they can be used to adjust the rankings of a few issues at the extremes, thereby improving the average results of the remaining issues.
- We include the long-term volume change effect in the Columbine Alpha model by reducing the rankings of stocks in the top two deciles that have experienced extreme increases in their trading volume over the past three years.
- We make use of the recent turnover effect by replacing low turnover issues in the bottom two rankings of the Columbine Alpha model with other negative momentum issues that have higher levels of recent turnover.
- Depending on the holding period, the two volume-related adjustments to the Columbine Alpha model add between 170 and 190 basis points per year to the model's average top-bottom decile spread (risk-adjusted).

INTRODUCTION

Many Columbine clients have asked what role trading volume plays in the Columbine Alpha price momentum methodology. This white paper provides an overview of the two volume adjustments we currently make to the Columbine Alpha rankings. One of these, long-term volume change, has been in use since 2001, but the other, recent turnover, has just been added to the model this year.

Trading volume was an integral part of "technical" analysis even before Edwards and Magee's classic treatise in the 1940s. A technician will study a stock's volume patterns to better determine the validity of its price moves: a stock rising on high volume is considered a positive indicator for future performance, while a stock rising on low volume is expected to give back its gains in the near future. These and other, more arcane measures of volume are staples of the technician's craft.

Despite the chartists' convictions in these matters, we did not make any use of volume information in the Columbine Alpha price momentum model for more than twenty years. The Columbine model estimates past persistent relative strength not explainable by each stock's changing beta and the market. Our innovation was, and remains, an optimization procedure that discovered appropriate weighting structures for both a stock's past price changes and the market's changes. (A recent *Columbine White Paper* [1] summarizes Columbine Alpha's advantages over simpler measures of price momentum.)

When we developed the model in the late 70s we did not consider our approach as "technical," but rather as a quantitative combination of relative strength analysis and the capital asset pricing model. Our focus was on the mathematical treatment of past price data, not volume. In the years that followed we did test simple measures of volume and turnover (volume divided by shares outstanding) with an eye toward improving the performance of the Columbine Alpha model. Unfortunately, none of the measures we looked at proved powerful enough to increase the model's predictive power for an entire decile of stocks.

LONG-TERM VOLUME CHANGE

During a periodic review of the Columbine Alpha model's structure in 2001 we confirmed that a then newly-reported volume phenomenon could add value in price momentum. Writing in the *Journal of Finance* in 2000, Lee and Swaminathan reported evidence that trading volume could predict the magnitude and effectiveness of price momentum. [2] Interestingly, the effect they observed was the reverse of the classic technician's rule. They found that the future return potential of stocks exhibiting positive price momentum is *reduced* if their volume has increased over the past several years. Specifically, they reported that high volume winners continue to win for a shorter period than low volume winners.

This novel discovery has been widely confirmed, but the theoretical explanations seem a bit contrived. They generally point to higher price momentum stocks with high volume as over-extended or glamour stocks. Other commentators have suggested that the long-term volume change effect captures the process of price discovery and "winners curse" as multiple bidders drive the stock price above "fair value." The underperformance following an increase in turnover may also represent an exit by momentum traders.

Lee and Swaminathan used simple one- through twelve-month past percentage change models as price momentum measures, but our testing confirmed the effect with the more sophisticated Columbine Alpha price momentum methodology. The measure we found most effective in conjunction with our proprietary price momentum compares a stock's current trailing twelve-month trading volume with its trailing thirty-six-month volume. Like Lee and Swaminathan we found that simple average trading volume works as well or better than turnover.

Sadly, even this long-term volume reversal effect is too isolated to enhance the performance of a full decile of stocks. It is, however, robust enough to be used as an overlay on price momentum to adjust the rankings of a few stocks at the extremes. We have implemented the long-term volume effect in our Columbine Alpha Factor rankings by adjusting the rankings of any issues in the top two deciles of Columbine Alpha that also have exhibited significant increases in volume (the top few percentiles of our long-term volume change measure). In any given week this adjustment moves about 5–10% of the stocks ranked 1 or 2 down to the 3 and 4 ranks, respectively. By

eliminating a few issues with lower probabilities of future outperformance from the top two ranks we can significantly improve the average performance of the remainder of the stocks in those ranks.

Lee and Swaminathan reported that loser stocks (negative price momentum) underperformed more on higher volume than on lower. In our testing the long-term volume effect was weaker in bottom-ranked momentum stocks and only improved their performance in 50% of all years. For this reason we chose to make use of the long-term volume effect only with positive momentum stocks.

Applying the long-term volume change metric to the positive momentum issues in a backtest of the Columbine Alpha model's top two rankings improved their average performance by 50 to 100 basis points overall, and improved results in 80% of the more than thirty years tested (1971-2003).

RECENT TURNOVER

The success of the long-term volume adjustment encouraged us to re-examine the volume work we had done in the past. Even if such measures were not powerful enough to improve the performance of entire deciles, it still might be worthwhile adjusting the rankings of a few stocks based on volume. We considered various measures of short-term volume and turnover, measured both as current levels and as change in levels. The most effective measure seemed to be a turnover metric, trailing six-month volume divided by shares outstanding. We found that stocks with high levels of recent turnover were a little more likely to perform as predicted by their Columbine Alpha rankings. That is, high positive momentum stocks outperformed even more, and extreme negative momentum stocks underperformed even more. This is corroboration of the classic technical interpretation of volume confirming price change.

As with long-term change, recent turnover provided a way to identify a few stocks, but the effect is not widespread enough to improve the performance of an entire decile. Our testing showed that the recent turnover effect works with both positive and negative price momentum stocks, but its yearly pattern of results in the top-ranked stocks proved too erratic to warrant use in production. Among bottom-ranked momentum stocks (9th and 10th decile Columbine Alpha), shifting low volume stocks out of these rankings and replacing them with higher volume stocks is worth doing, adding roughly 100 basis points of active return at all holding periods, and improving the average performance of the bottom two deciles in more than 60% of all years. After making the recent turnover adjustment the number of stocks ranked 9 or 10 fluctuates around a full decile count, but is about the same on average. We checked to see if these new adjustments introduced price or capitalization biases, and found none.

PERFORMANCE

The results reported here are based on our testing of monthly model rankings in the stocks of the Columbine 1500 universe over the years 1971 through 2003. We present active returns (decile return minus universe return) for equal-weighted deciles of stocks. The results are annualized to permit comparison across different holding periods. All returns include re-invested dividends and are gross of transactions costs or other fees.

The graphs that follow illustrate return and volatility comparisons, risk-equivalent return comparisons, and year by year consistency. To provide a baseline for the results we have included the performance of a simple twelve-month percentage change model as a proxy for simpler, non-beta-corrected forms of price momentum. This twelve-month model is referred to on the graphs as **Model T**. The pre-2001 Columbine Alpha model without any volume-based adjustments is labeled

Model CA-V, and the current version of the Columbine Alpha model, including the effect of adjustments for both long-term volume change and recent turnover, is labeled **Model CA+V**.

January Treatment

In the US, intermediate-term and long-term price momentum shows reversed performance in some Januarys. In order to remove this effect from the study we excluded the rankings made at the first of January for all three models. It turns out that Columbine Alpha extreme deciles suffer less from January reversals then do simple relative strength measures like Model T. Including Januarys in the testing would give an additional annualized return advantage to Columbine Alpha's 1st decile performance of 17 basis points at one-month holding and 50 basis points at six-month holding. At the twelve-month time horizon there is no additional Columbine Alpha advantage in January.

Top and Bottom Deciles: Returns and Risk

The first set of graphs (**Figures 1–3**) compares active return and volatility of return for the 1st and 10th deciles across the three models at holding periods of one, six, and twelve months. You can see that moving from the simple Model T to the Columbine Alpha methodology (Model CA-V) generally increases return and decreases volatility. Incorporating volume effects (Model CA+V) generally improves return, but doesn't change volatility much. The bar charts in **Figure 4** illustrate this improvement on a risk-equivalent basis. We adjusted all returns to the same volatility by projecting Model CA-V and Model T's percentage change returns from the origin until their volatility matched that of the new volume-adjusted Model CA+V.

Figure 4 shows that adjusting Columbine Alpha for volume effects (Model CA+V) adds more than 100 basis points on average over the previous version (Model CA-V), and is many hundreds of basis points better then simple Model T. Indeed, for 1st deciles Model CA+V offers about twice the risk-adjusted return of twelve-month relative strength. We estimate the statistical significance of the top and bottom decile differences between Models CA-V and CA+V at about two sigma for all three holding periods. The difference between Columbine Alpha and Model T is significant at more than six sigma.

A comparison of the average information coefficients generated by the three models confirms the advantages of beta adjustment and optimal weighting (Model CA-V vs. Model T), and of adding volume adjustments (Model CA+V).

Stability of Enhanced Columbine Alpha

The last graph (**Figure 5**) shows the year-by-year pattern of Model CA+V's average annual improvement over Model CA-V. The metric illustrated by the graph is the annual difference between each model's average top- minus bottom-decile spread return. The results are based on one-month holding periods from 1971 through 2003. We computed the difference by subtracting Model CA-V's spread from Model CA+V's, so a positive number for a given year means that the volume-adjusted version of the Columbine Alpha was superior to the un-adjusted model on average in that year.

Adjusting Columbine Alpha for volume effects improved the model's overall discriminatory ability in twenty-one of the thirty-three years studied. Since the volume-adjusted model is superior in the majority of years, we looked for any pattern in the years when it failed to outperform the simpler model. There does not seem to be any correlation with market direction. The only year when Model CA+V significantly underperformed Model CA-V is 1991. That year's large underperformance does not represent a failure in the absolute sense; both

models generated above-average positive spreads that year.

CONCLUSION

Trading volume does have a role to play in price momentum, but it seems to be limited to a few stocks exhibiting extreme behavior. Despite the concept's importance to technicians we have not been able to find volume-related additions to price momentum that will improve the performance of an entire decile of stocks; but smaller increments of improvement are possible. Stocks with positive momentum whose volume has increased dramatically over the past three years are less likely to outperform than their peers and should have their price momentum ranking reduced accordingly. Conversely, negative momentum issues with high recent levels of turnover are more likely to underperform than those with low turnover. Replacing the low turnover issues with their higher turnover peers is worth doing.

We never stop looking for improvements to Columbine Alpha and all of our models. The volume-related adjustments described here are simply the latest manifestations of Columbine's *kaizen* philosophy of model construction. Perhaps we will find other enhancements in the future.

NOTES

1. See the Columbine Capital Services White Paper, "Price Momentum—A Twenty Year Research Effort," August 2001, available on the Columbine website: www.columbinecap.com. An earlier version of this review of multiple price momentum models appears in J. Brush, "Eight Relative Strength Models Compared," *Journal of Portfolio Management*, Fall 1986, pp. 21-28.

2. Lee, Charles M.C., and Bhaskaran Swaminathan, 2000, Price Momentum and Trading Volume, *Journal of Finance* 55, 2017–2069.

Figure 1 -- 1st and 10th decile Results: 1-Month Holding Period

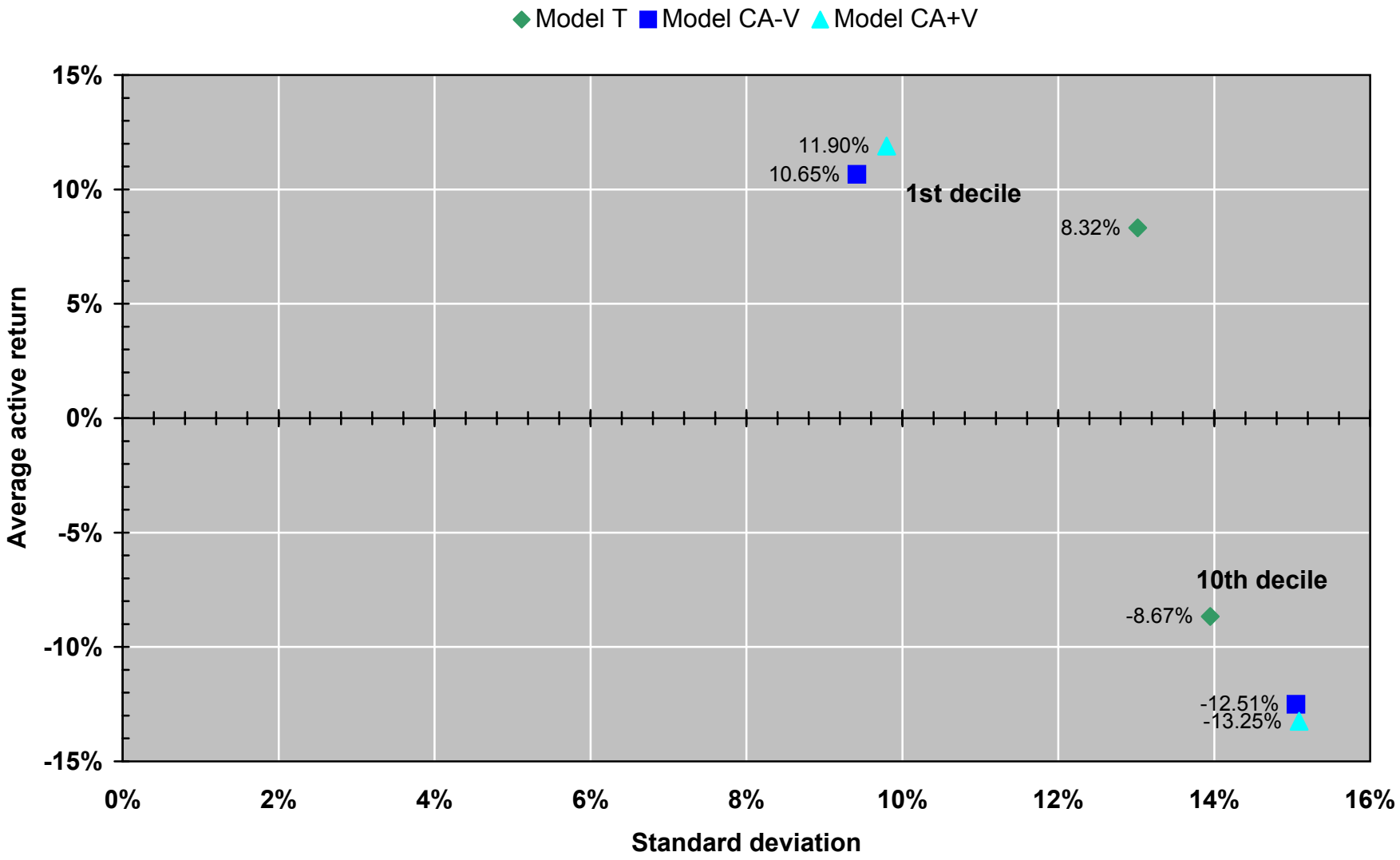

Figure 2 -- 1st and 10th decile Results: 6-Month Holding Period

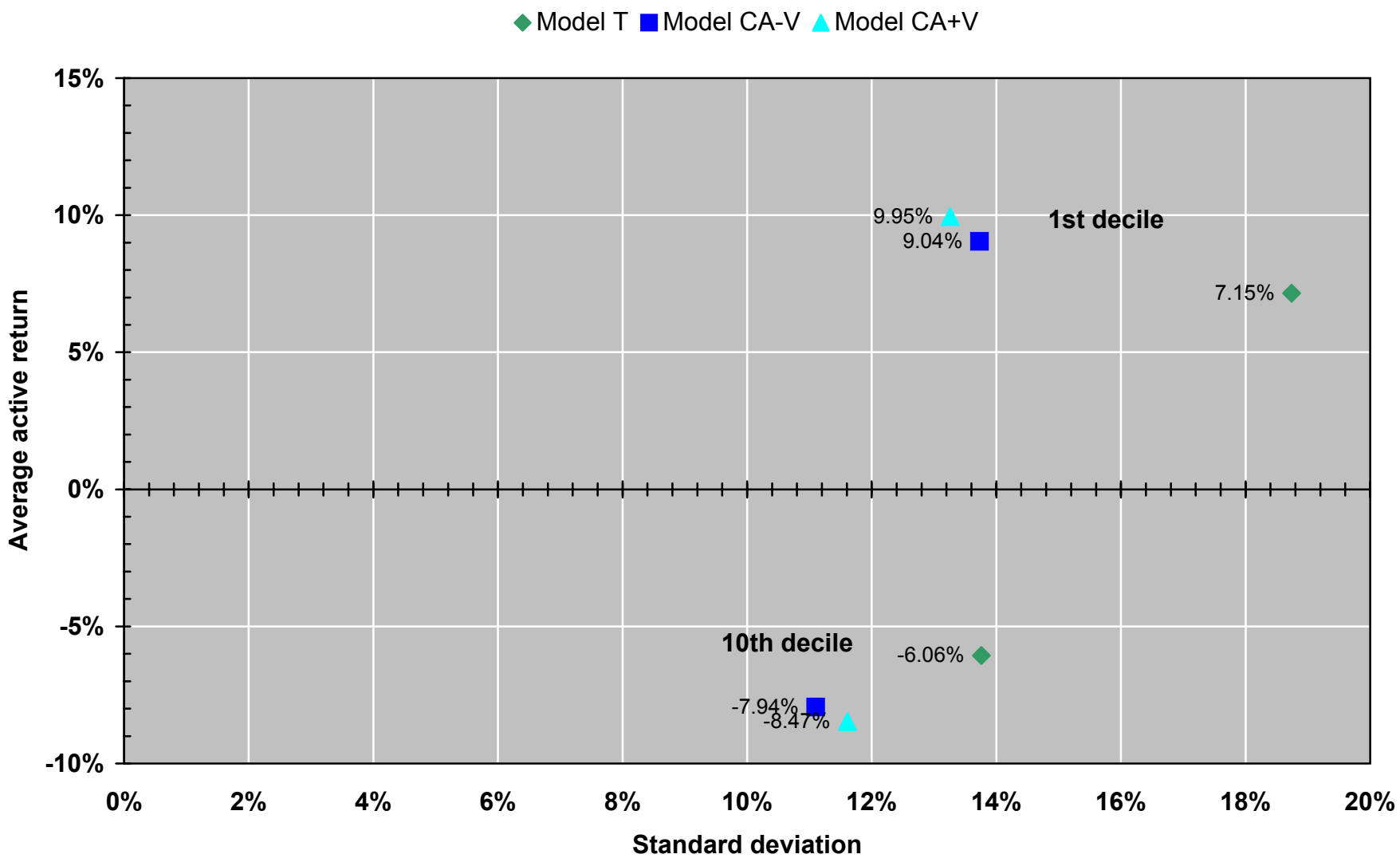

Figure 3 -- 1st and 10th decile Results: 12-Month Holding Period

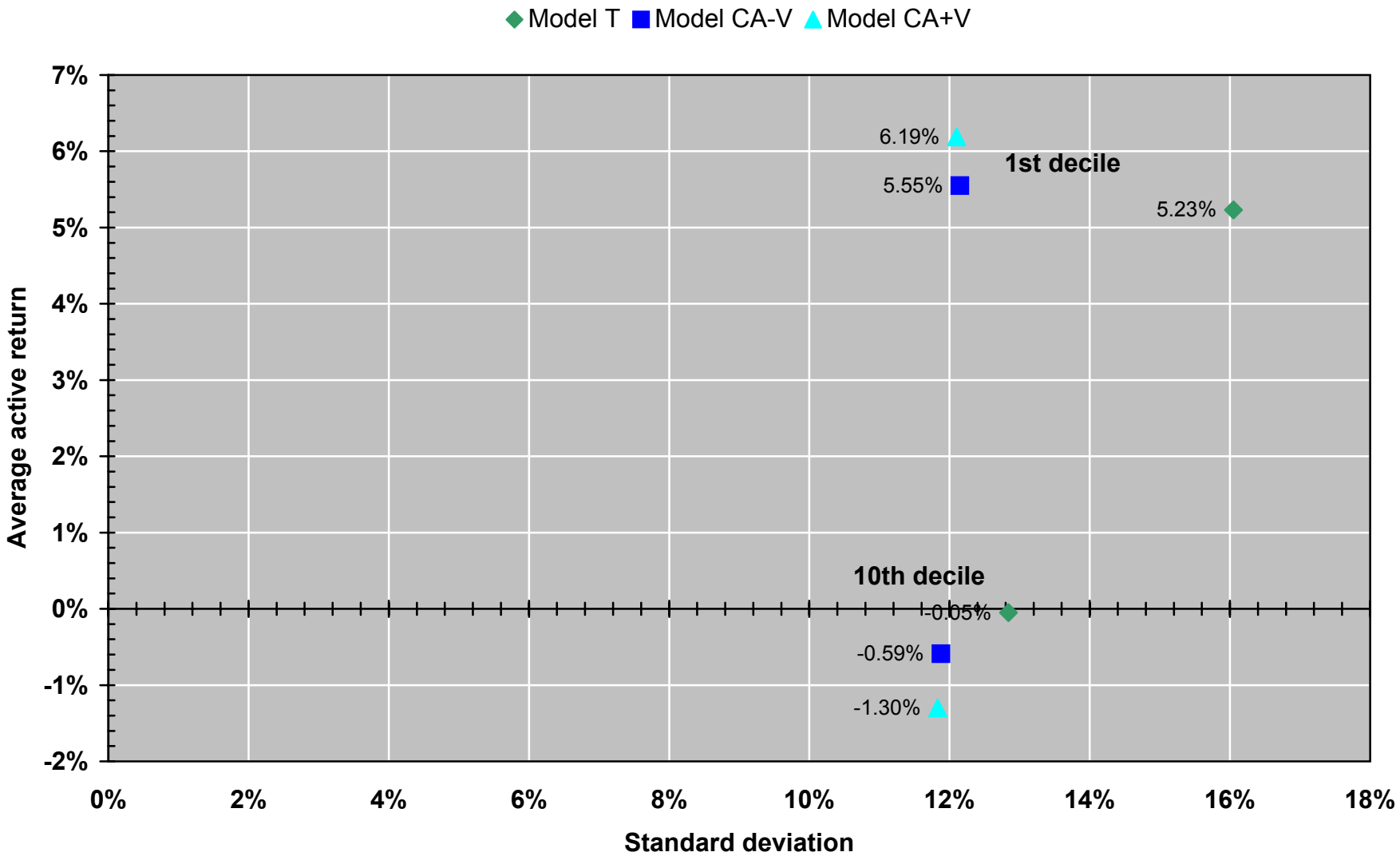

Figure 4 -- Risk-adjusted Average Active Return: 1st & 10th Deciles

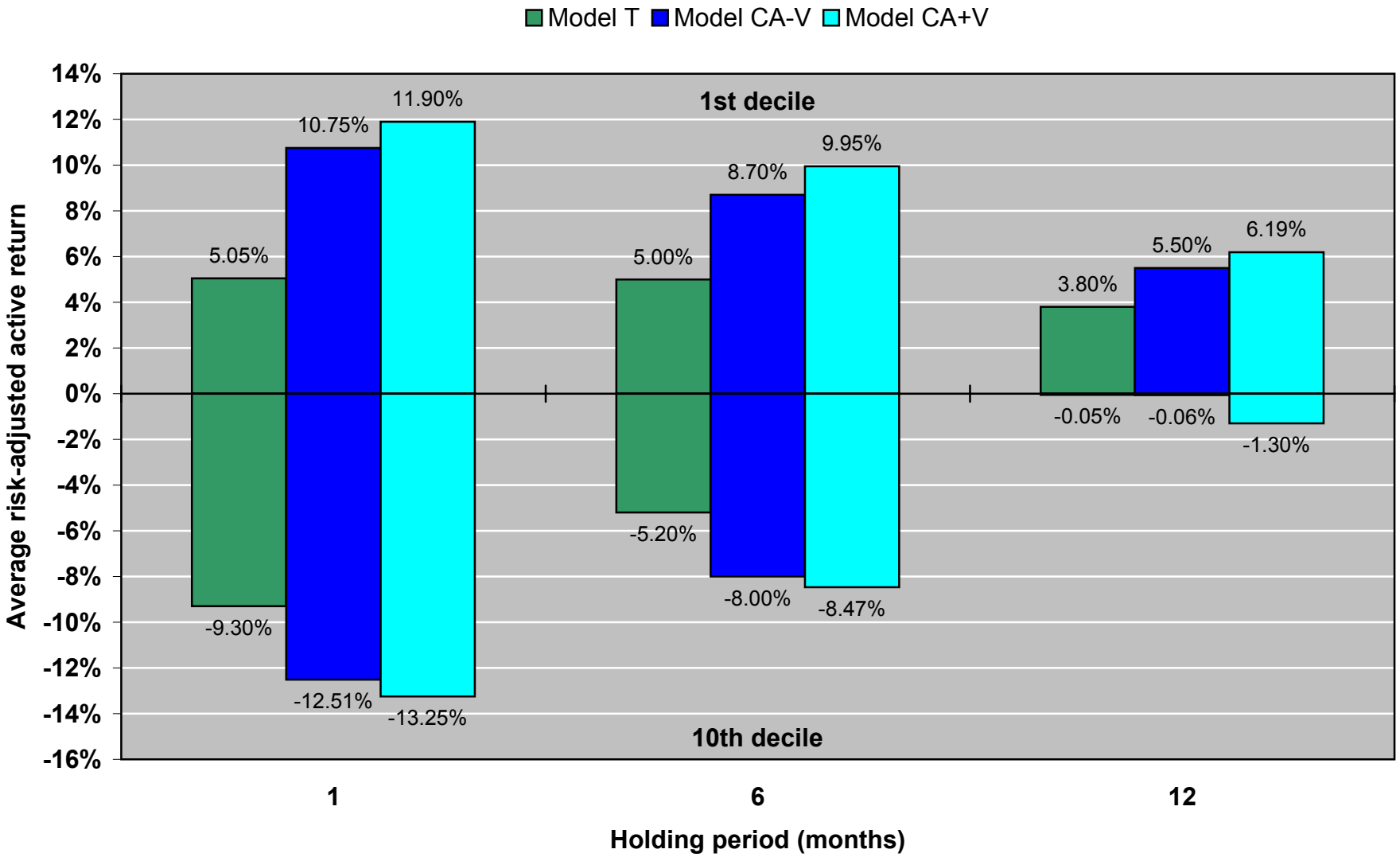

Figure 5 -- Annual Improvement in Top/Bottom Decile Spread