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LET IT RIDE OR LOCK IT IN?

The impact of dynamic versus static position sizing on trend-following performance.

#20 | DECEMBER 2024

Executive summary

In this research note, we examine the performance differences among three distinct systematic methods for managing notional and risk exposure of individual positions in a representative trend-following strategy.

The simplest method, for a given signal level, maintains a constant initial number of contracts throughout the life of a trade, while the other two models dynamically adjust the number of contracts to achieve a constant notional exposure or a constant risk exposure (or dynamic volatility-based position sizing), respectively.

We begin with a straightforward illustrative example – a single trade capturing the surge in cocoa futures prices between 2023 and 2024 – to illustrate how different position sizing methodologies can lead to drastically different outcomes based on an identical signal. However, when analyzing return distributions across a sample of 2,750 trades spanning 50 markets over the past 30 years, we observe minimal differences in average returns among the three models, with notable distinctions appearing only in the top 25% of the winning trades.

We show that, compared to a static approach, dynamically scaling market exposure inversely to volatility has no impact, positive or negative, on the risk-return profile of losing trades. However, it does enhance the risk-adjusted return profile of the quartile of most profitable trades – albeit at the cost of capping absolute per-trade returns. This result is supported by a pattern observed in the change in market volatility across the lifecycle of the 25% most profitable trades (which is not seen across the sample of losing trades), where volatility is 1.4 times higher on average during their lifetime compared to entry, acting as a take-profit mechanism.

Our analysis reveals that a more concentrated risk approach (i.e., not adjusting exposure to changing market conditions) does not lead to superior long-term risk-adjusted returns. While the difference can be significant on a trade-by-trade basis, particularly for the most profitable trades, the impact of dynamically managing individual position exposures on the long-term performance of a trend-following strategy is surprisingly limited. Nevertheless, the results suggest that dynamically adjusting exposures inversely to market volatility offers the best balance between managing portfolio concentration risk and optimizing long-term performance. While it may limit individual trade profits, it prevents excessive concentration and reduces the risk of large losses from a single position, all without sacrificing overall strategy risk-adjusted returns.

Introduction

Among the most notable price developments and enduring market trends in recent years has been a sustained rise in the price of cocoa futures. For trend-following managers with cocoa in their investment universe, this contract likely emerged as a top performer, contributing significantly to returns in both 2023 and 2024. Once relatively overlooked by investors, cocoa futures gained widespread attention in early 2024, fueled by an exponential rise in prices and a surge of media coverage.

The persistent uptrend in cocoa prices from 2023 to 2024 exhibited a striking feature: a parallel and sustained increase in market volatility. While the annualized volatility of the most actively traded cocoa futures contract in the US averaged around 20% p.a.[1] throughout much of 2023, it surged to over 120% p.a. during the first half of 2024, coinciding with an acceleration in price gains (see Figure 1). In such a market environment, an instrument like cocoa can drive substantial dispersion among trend-following managers, influenced by factors such as their specific risk management approaches and position sizing methodologies.

This note quantifies the impact of different position sizing techniques on the profitability of capitalizing on an outlier trend, such as the cocoa trend in 2023 and 2024. It also places this trade in a longer-term historical context by analyzing the impact of three different position sizing methods on the performance of 2,750 simulated trades since 1995, using a representative trend-following system implemented on an investment universe of 50 futures markets.

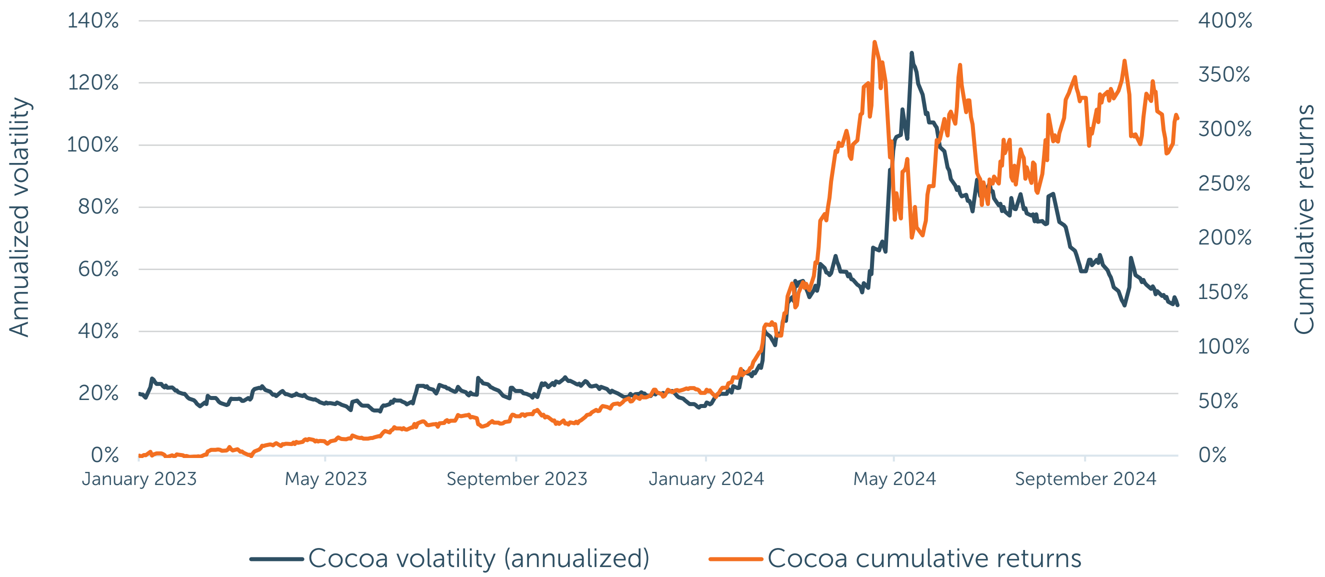


Figure 1: Cumulative returns and rolling annualized volatility of the most actively traded cocoa futures contract for the period January 2023 - October 2024. Volatility is measured using an exponential moving average method with a 0.94 decay factor. Source: Quantica Capital.

[1] Volatility is measured using an exponential moving average method with a 0.94 decay factor.

Different approaches to instrument position sizing

The exposure of a trend-following CTA to a particular market has always been a function of some measure of the market's risk. For example, the success of the experimental Turtle Traders program[2], which began in 1983, has had a profound influence on the emergence of a trend-following CTA industry, with several CTAs founded by former Turtle Traders still active today. The model implemented by the Turtles in the 1980's used the concept of volatility[3] to size initial positions in markets with varying levels of risk.

While sizing a position based on an initial measure of market risk may seem intuitive, managing that position over its lifetime involves several decisions. One key decision is whether the position exposure should remain static or evolve in response to changing market conditions. Today, a common approach to position sizing and exposure management adopted by many trend-following CTA managers is to scale a market's exposure inversely proportional to the evolution of its volatility. As a market's volatility increases (decreases), the dollar amount invested is decreased (increased) to maintain the desired level of risk. We will refer to this process as *dynamic volatility-based position sizing*. In contrast, a static approach keeps the initial position constant as long as the signal remains positive or negative, at which point the position is exited.

Building on the cocoa market trend example of 2023–2024, we will analyze the impact on profitability of initiating a position and holding it constant regardless of market volatility, versus dynamically adjusting it in response to changes in prices and volatility, respectively. We will put the observed differences for that specific trade example into a longer-term historical context, exploring and comparing the return characteristics of over 2,750 simulated trades - both winning and losing - across 50 futures markets over a 30-year period, with and without dynamic position sizing. After providing a high-level overview of the key characteristics of the sample of winning and losing trades, we will delve deeper into identifying patterns in volatility changes between trade entry and exit. This will help us to understand the typical behavior of dynamic volatility-based position sizing versus a static approach throughout the lifecycle of a trend-following trade. We will then examine the differences in per-trade return and risk-adjusted return statistics between a dynamic and static approach, followed by an evaluation of these same metrics at the strategy level.

Before delving into the analyses, we will first introduce a simplified yet representative trend-following system and three different position sizing methodologies.

[2] The Turtles, a set of people recruited from an ad placed in The Wall Street Journal, were trained for two weeks in markets, trading and risk management, and were provided with systematic trading rules to implement a trend-following strategy. More details about the Turtle Traders program can be found in the following episode of the Top Traders Unplugged podcast, TTU13 – Lessons From the Most Successful Turtle of All-Time with Jerry Parker (July 2014), featuring Jerry Parker, one of the original turtles: https://www.toptradersunplugged.com/podcast/013-2/

[3] Through what Richard Dennis and Bill Eckhardt called "N", the 20-day exponential moving Average True Range (ATR) of a market. The ATR is a volatility indicator from technical analysis reflecting the average range by which prices swing for a market over a specified period.

Introducing a simplified trend-following system composed of a discrete three-state signal and different position sizing mechanisms

To isolate the impact of static versus dynamic volatility-based position sizing on trend-following performance, we will rely on a straightforward trend-following system, featuring a discrete three-state signal:

- +1 when the market is trending up,
- -1 when it is trending down, and
- 0 when no strong trend is detected in either direction.

The underlying signal is a discrete version of Quantica's generic trend following model, which has been designed to replicate the positions and returns of a typical trend-following benchmark such as the SG Trend Index[4].

We will compare three distinct implementations of this approach. In all three approaches, a market's initial exposure is scaled inversely in relation to its volatility at the time the position is opened. However, for a given long (+1) or short (-1) signal:

- The **Static Contracts** model targets a constant number of contracts[5] for each market. The initial position is translated into a fixed number of futures contracts and kept constant until that position is closed. This approach implies a (passive) time-varying notional and risk exposures for each market. As the price change, so is the value of each contract, resulting in the notional exposure changing over time, along with a corresponding change in the position's risk exposure.

- The **Static Notional** model targets a constant notional exposure for each market. The initial US Dollar notional position (or equally as a percentage of the net asset value) is kept constant until that position is closed. This approach means that if the price rises (falls), the value of each contract increases (decreases), and contracts are sold (bought) to maintain a constant notional exposure.

- The **Dynamic** model targets a constant risk exposure for each market. The initial position is adjusted every day, inversely in relation to the evolution of market's volatility[6], following the *dynamic volatility-based position sizing* methodology. This approach implies a time-varying notional exposure for each market: as market volatility increases (decreases), the notional exposure is adjusted downward (upward) to maintain a constant risk level.

An overview of the investment process of our simplified trend-following system is provided in Figure 2.

[4] The model relies on the sign of the exponentially weighted moving average of an instrument's past risk-adjusted log returns. This signal is transformed via a continuous, increasing, and bounded function into a discrete three-state signal of +1, -1 or 0, based on some pre-defined thresholds. The monthly returns of the model with different position sizing methodologies used in this research note display correlations between 0.79 and 0.83 to the returns of the SG Trend Index since its inception in 2000. The SG Trend Index is designed to track 10 of the largest trend-following CTAs (by AUM) which meet a list of criteria (as defined by SG) and be representative of the trend-followers in the managed futures space. The SG Trend Index is equally weighted, and rebalanced and reconstituted annually. The Index is not directly investable. Source: Société Générale.

[5] A "contract", or "lot", is the standardized number of units traded in a futures market. For example, for WTI Crude Oil, 1 contract (equally: 1 lot) represents 1000 barrels of oil.

[6] The speed of the volatility estimator used in this model is faster than the signal speed. The volatility estimator uses a decay factor of 0.94, corresponding to a span of 32 observations, while the medium-term trend following system is designed to target trends lasting a calendar quarter and longer.

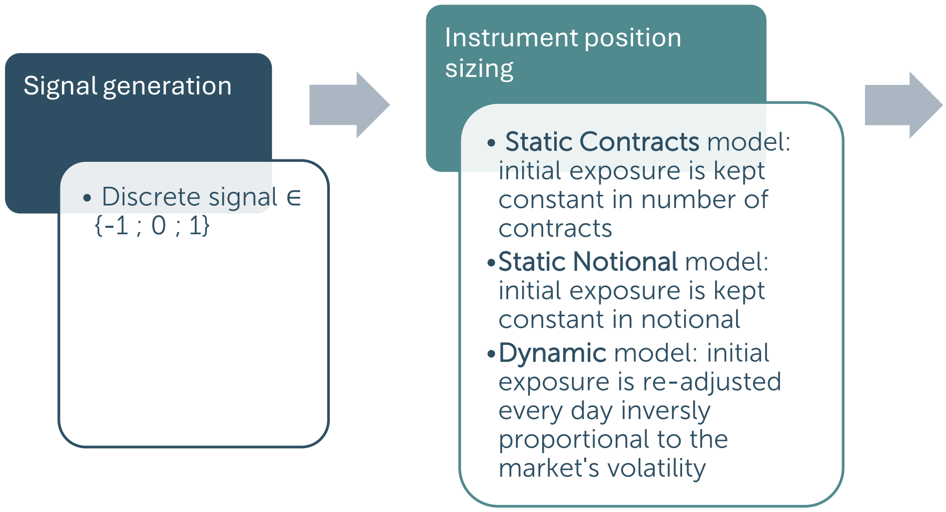


Figure 2: Description of a simplified trend-following system featuring a discrete three-state signal. Three distinct implementations for instrument position sizing are considered: Static Contracts, Static Notional, and Dynamic models. In each case, the initial exposure is scaled inversely in relation to the market volatility at the time of opening. Source: Quantica Capital.

Applying this simplified trend-following system to a diversified investment universe of 50 of the most liquid futures contracts across equities, government bonds, short-term interest rates, currencies, and commodities on the past 30 years of data since 1995 results in 2,750 individual *trades*. We define a "*trade*" as the returns generated from the entry until the exit of a position in a given instrument, i.e. during a period when the signal (and corresponding market exposure) shifts from 0 to either +1 or -1, and then reverts back to 0.

"Cut Your Losses and Let Your Profits Run"

Figure 3 shows the distribution of trade durations for the *Static Contracts* model, categorized by whether they were profitable or loss-making. High-level trade statistics for each of the three models are reported in Appendix 1. For each of the three models considered, 63% of the trades result in losses, averaging 38 business days in duration, while 37% of trades are profitable, with winning trades averaging a significantly longer duration of 192 business days. Similarly, for all models, the average total return for a winning trade is between 3 to 4 times the average loss of a losing trade. This aligns with the intuition that a medium-term trend-following strategy tends to produce frequent but limited losses alongside fewer, but more substantial, winning trades.

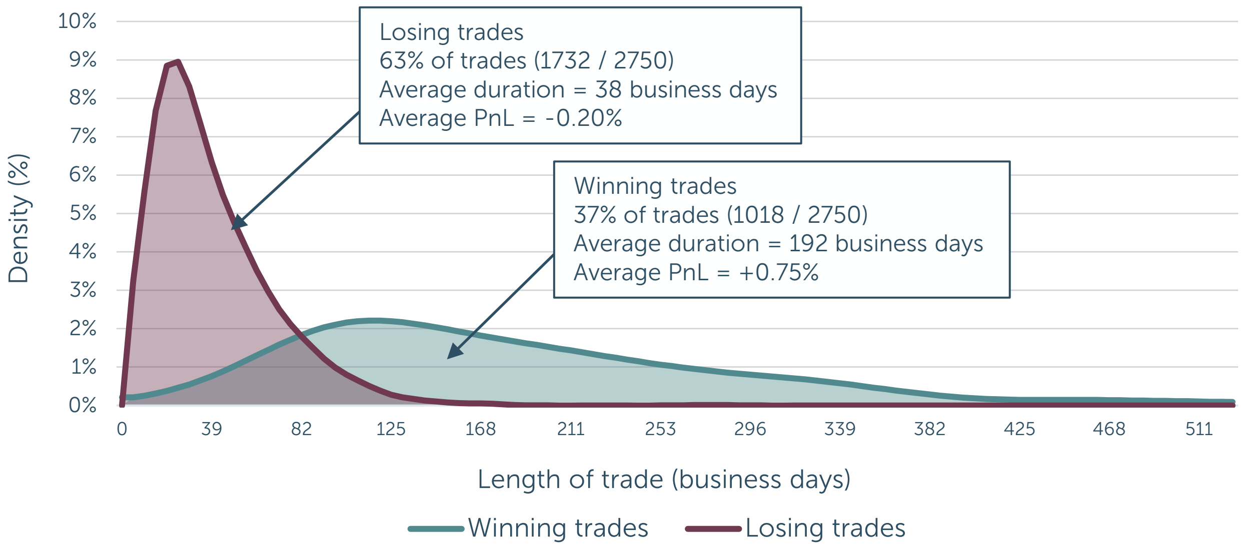


Figure 3: Conditional distributions of the duration (in business days) of the winning and losing trades for a simplified trend-following system featuring a discrete three-state signal and a position sizing methodology based on the Static Contracts model as described in Figure 2. Average PnLs reported are gross of trading costs. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

As the core discrete signal underlying the three models is identical, each trade is opened and closed on the exact same dates. Additionally, for all three models, the same notional and risk exposures are applied when a position is initially opened[7]. The three models differ solely in how individual positions are sized throughout the duration of a trade.

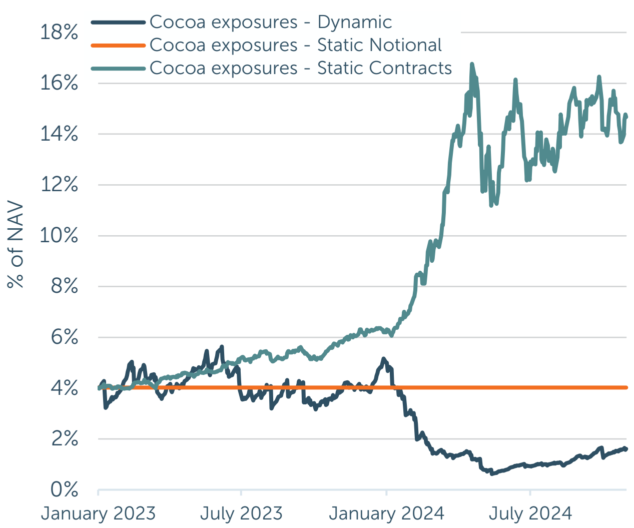
Before analyzing how different position sizing methodologies impact the risk-return profiles of this set of simulated trades, we will first examine the 2023-2024 cocoa trend to demonstrate how the three models performed in capturing its upside.

[7] The initial exposures are additionally multiplied by a constant of 0.4 – the same for all trades and for the entire period – chosen so that the overall simulated strategy displays a realistic annualized volatility in line with industry average. As an example, for a universe composed of 50 markets, the initial exposure of a market with a 20% p.a. volatility at the time of opening the trade will be equal to: (constant)*(1/volatility)*(1/number of instruments), i.e. 0.4*(1/0.2)*(1/50) = 4% of notional. The constant of 0.4 is not relevant in the context of this note as the overall leverage of the portfolio is ignored. No overall portfolio volatility rescaling is applied to completely isolate the impact of dynamic volatility-based position sizing from all other effects.

Quantifying the performance of different position sizing methodologies in capturing the cocoa trend of 2023-2024

First, of the 2,750 simulated trades, the cocoa trade of 2023 – 2024 ranks in the top 10 by total return across all three models. This highlights the exceptional nature of the trade, given the long 30-year history and the large number of markets (50) considered.

The significant rise in cocoa futures prices and volatility in 2023 and 2024 exemplifies how different position sizing approaches can lead to very distinct results on a single trade basis. Our simplified trend-following system would have initiated a trade in cocoa futures in January 2023, when the instrument volatility was around 20% p.a. During their extended upward trend, the volatility of cocoa futures rose significantly, surpassing 100% p.a., while the market itself rallied a cumulated 300% (see Figure 1). This would have led to significant dispersion between the three different instrument positioning methodologies: a model that incorporates dynamic volatility-based position sizing would have closed more than 60% of the initial exposure in response to rising volatility, while a model that keeps the number of contracts constant would have seen its initial notional exposure quadruple in response to the increase in prices (see Figure 4, left-hand side). On the right-hand side, Figure 4 shows the difference in corresponding performance of that single cocoa trade for the Dynamic model as well as for the two Static models. Given the same initial exposure at the beginning of the trade, the dynamic volatility position sizing model would have produced a hypothetical total return of 4.3% with an annualized Sharpe ratio of 2.8, while the model targeting a constant number of contracts would have produced a three times higher hypothetical return of 12.5%, but with a higher risk (resulting in a lower annualized Sharpe ratio of 1.1). The third model, which targets a constant dollar exposure, would have ranked in between, delivering a hypothetical return of 6.8%, with an annualized Sharpe ratio of 1.9.



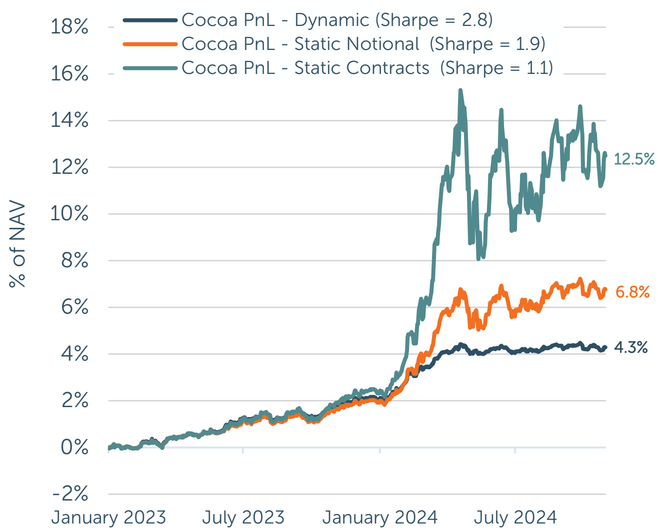


Figure 4: Left: Notional dollar exposures (% of Net Asset Value) in cocoa futures for a simplified trend-following system based on three different position sizing models (Static Contracts, Static Notional and Dynamic) as described in Figure 2 over the period January 2023 – October 2024. Right: Corresponding cumulative return contribution from cocoa futures for the three different models over the same period. No trading costs are included. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

Figure 4 is unequivocal: rising market volatility functioned as a take-profit mechanism with the Dynamic model, as the increase in volatility led to a reduction in most of the initial exposure, thereby also limiting the upside of the trade. The same observation holds with the Static Notional model: the increase in price led to a gradual reduction in the number of contracts held in the position, thereby limiting the upside of the trade, but to a lesser extent than with the Dynamic model.

In contrast, the Static Contracts model capitalized on the higher volatility, fully maximizing the upside potential. This observation naturally raises the question of how frequently such a volatility increase acts as a natural profit-taking mechanism when examining the full sample of trades over a 30-year period. Specifically, how many of the successful trades in the past have coincided with a gradual increase in market volatility over the trade lifecycle?

To answer this question, the next section will quantify the average changes in market volatility from trade entry to exit across the entire sample of winning and losing trades.

Exit-to-entry volatility patterns across the lifecycle of losing and winning trades

The set of 2,750 simulated trades is divided into two distinct groups: winners and losers. We rank all loss-making trades on one hand, and all profitable trades on the other by their total return contribution, dividing each group into four quartiles.

As per Figure 5, relying on the implementation of the Static Contracts model, we observe that, on average, the volatility of a market at the time of exiting a trade is higher than at the time of entry, with this effect being most pronounced in the quartile of the most profitable trades. More generally, the profitability of a trade is positively correlated with the *exit-to-entry volatility ratio*, indicating that more profitable trades tend to exhibit higher volatility upon exit compared to entry. Across all four quartiles of winning trades, the average market volatility at the time of closing the trade is 1.2 times higher than the volatility of that same market at the time of entry. This number goes up to 1.6 for the top 25% of profitable trades. The same pattern is observed for the average volatility throughout the lifetime of a trade: more profitable trades trend to exhibit higher average volatility during their lifetime compared to the volatility of the traded market at the time of entry (orange bars in Figure 5). The top 25% of profitable trades display an average-to-entry volatility ratio of 1.45.

Conversely, across all four quartiles of losing trades, the average *exit-to-entry volatility ratio* is only 1.05. Similar to the top 25% of winning trades, we observe a "burst" in volatility for the bottom 25% of losing trades. However, with an average exit-to-entry volatility ratio of 1.2, this burst is much smaller[8].

[8] This is intuitive as these trades are usually closed after sharp reversals in prices, making them the least profitable trades for a trend-follower.

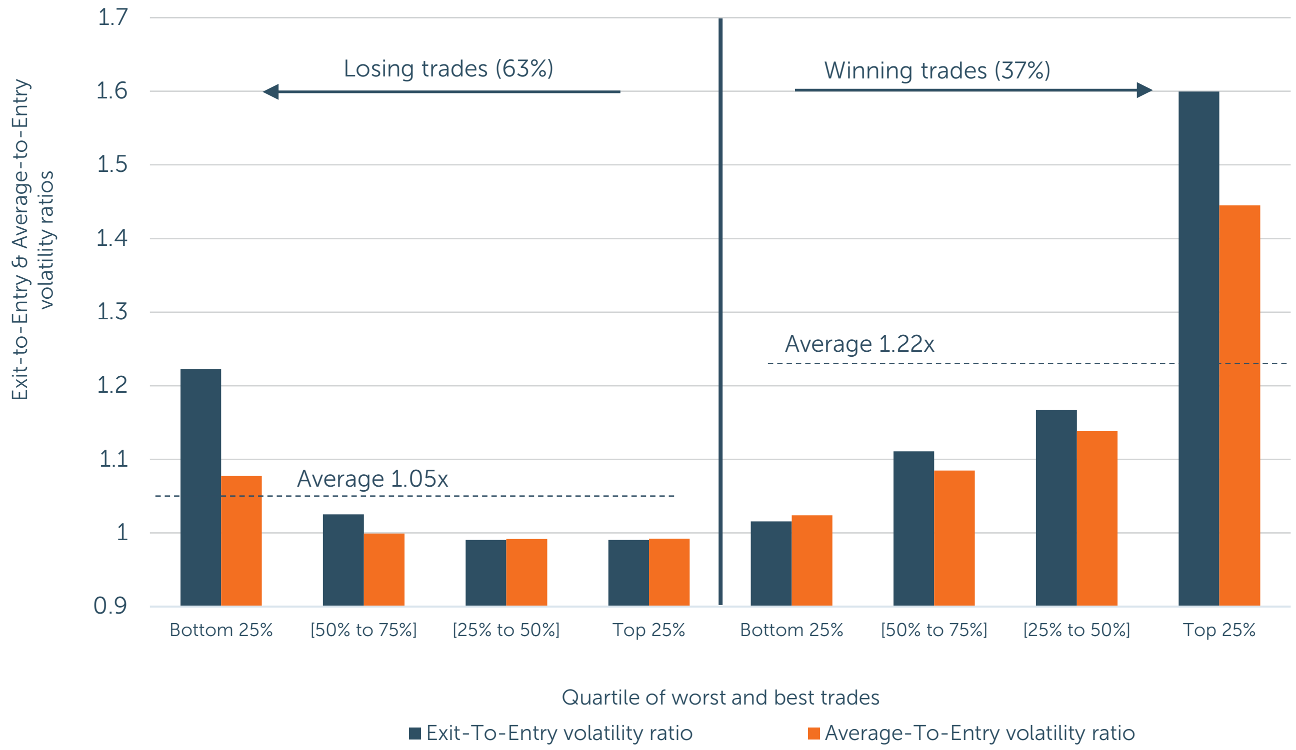


Figure 5: Exit-to-entry and average-to-entry volatility ratios for each quartile of winning and losing trades for a simplified trend-following system based on the Static Contracts position sizing model as described in Figure 2. Each quartile of unprofitable trades consists of 433 trades, while each quartile of profitable trades contains 255 trades. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

Because the entry and exit dates for each trade are exactly the same across all three models, exit-to-entry volatility ratios are highly similar for the other two models[9].

The higher volatilities observed in Figure 5 for the most profitable trades suggest that, with a dynamic volatility-based position sizing approach, there will be a consistent notional position reduction throughout the lifetime of a trade. The next section will quantify the magnitude and distribution of this exposure reduction for the different quartiles of winning and losing trades.

Dynamic volatility-based position sizing as a take-profit mechanism

With the dynamic, volatility-based position sizing methodology, a decrease in instrument volatility after entering a trade will result in an increase in the long or short notional exposure relative to the initial exposure at entry. Conversely, an increase in instrument volatility post-entry will result in a reduction of notional exposure. Building on the previous analysis, we now quantify the average exit-to-entry change in notional exposure for each quartile of winning and losing trades, resulting from the application of the dynamic, volatility-based position sizing methodology.

[9] More than 95% of the trades' total returns have the same sign between the three strategies and a very good (bad) trade for a given position sizing methodology is likely to also be a very good (bad) trade for another position sizing methodology.

The results shown in Figure 6 are consistent with those in Figure 5:

- Across the set of all *unprofitable* trades, dynamic position sizing – on average – turns out to have a negligible impact on a market's notional exposure. The median change in exposure due to fluctuations in volatility is approximately 0% for each of the four quartiles of losing trades.
- Across the set of all *profitable* trades, the impact of dynamic position sizing becomes more pronounced with increasing trade profitability. In fact, for the top quartile of the most profitable trades, dynamic position sizing leads to a median reduction of 30% in notional exposure, leading to a gradual and partial profit realization of the position.

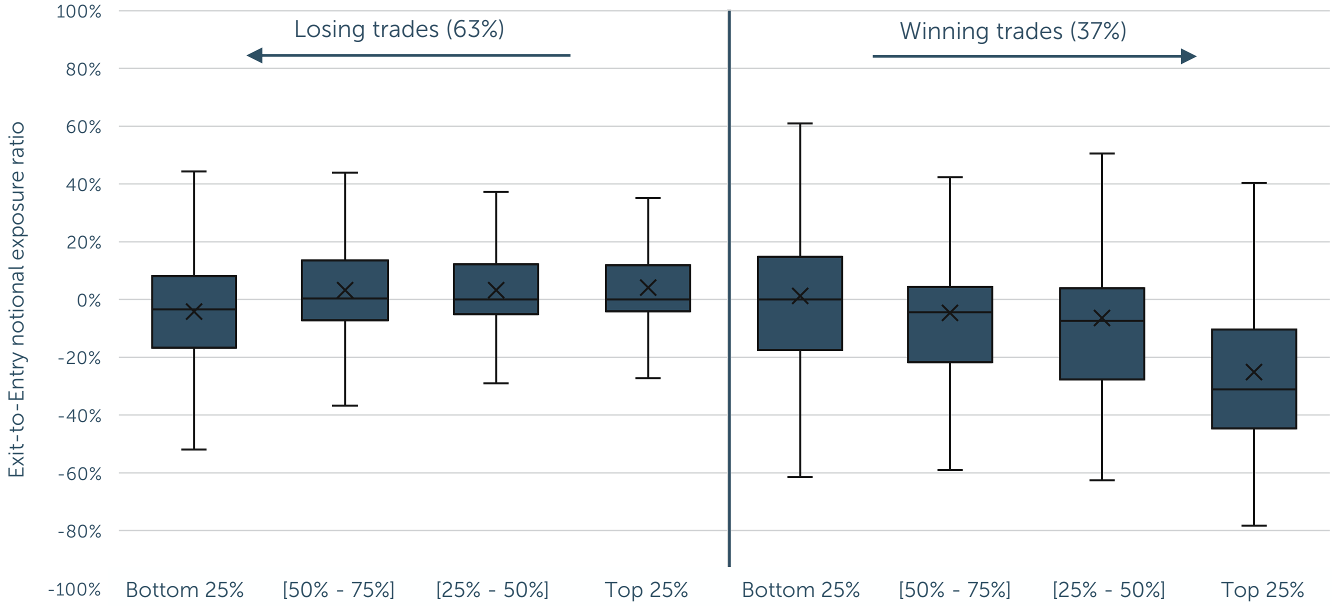


Figure 6: Distribution of exit-to-entry notional exposure ratios for each quartile of winning and losing trades for a simplified trend-following system based on the Dynamic position sizing model as described in Figure 2. Each quartile of unprofitable trades consists of 429 trades, while each quartile of profitable trades contains 258 trades. Each box is bounded by the first quartile (Q1) and third quartile (Q3), representing the interquartile range (IQR). The median is shown as a line within the box; the average by a cross. The whiskers extend to the most extreme data points that are within 1.5 times the IQR from the box edges (Q1 - 1.5 × IQR and Q3 + 1.5 × IQR). Any data points outside this range are considered outliers and are not shown here. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

Having illustrated the difference in typical exposure dynamics over the lifecycle of a trade between models with and without position sizing, we will now quantify the different risk-return profiles induced by the three position sizing methodologies.

Comparing the risk-reward profile of winning and losing trades for different position sizing approaches

Figure 7 provides an overview of the comparative distributions of the total returns and corresponding t-statistics[10] (risk-adjusted returns) of the trades, for each quartile of winning and losing trades, across the three models. A full table of descriptive statistics associated with Figure 7 is provided in Appendix 2.

It is striking that for all quartiles, except for the top 25% of the most profitable trades, the three models show very similar average total returns per trade. The only notable difference is observed within the top 25% of the most profitable trades. For this top quartile, the Static Contracts model generates the highest total return, averaging 2% per trade, followed by the Static Notional model at 1.9% and the Dynamic model at 1.6%. Put simply, a static approach offers slightly more upside on average than a dynamic volatility-based approach for the quartile of the most profitable trades. The dispersion of returns in this quartile is by far the largest of all quartiles, as these are the trades with the longest duration. Longer trade duration is associated with greater volatility fluctuations, which in turn leads to a wider range of outcomes.

These results are also consistent from a risk-adjusted returns perspective. Notable differences in average trade t-statistics between the three different position sizing models are only observed in the top 25% of winning trades. In this case, however, the dynamic position sizing approach achieves the highest average trade t-statistic of 1.75, compared to 1.55 for the Static Notional model and 1.45 for the Static Contracts model.

While differences in absolute and risk-adjusted returns generated by different position sizing methods can be significant at the individual trade level, as demonstrated by the cocoa example, these differences tend to be averaged out across a larger sample of trades.

While dynamic position sizing based on market volatility can be seen as a more prudent risk management strategy, our hypothetical results suggest that it does not improve the risk-reward profile of the losing trades. The greatest impact is seen in the most profitable trends, where the embedded take-profit mechanism limits the upside potential, but slightly enhances the risk-adjusted return profile.

Having examined the differences in per-trade return and risk-adjusted return statistics across the three models, we now turn to analyzing how these models affect the same metrics at the aggregate, or strategy, level.

We will show that while the initial cocoa example suggested that position sizing could result in significant return dispersion between static and dynamic approaches at the trade level, its overall impact at the portfolio level, both in terms of absolute returns and risk-adjusted returns, is limited.

Individual position sizing methodologies have only a limited impact on the long-term risk-adjusted performance of a trend-following strategy

Table 1, which compares the hypothetical performance of our simplified trend-following system from 1995 to 2024, implemented using the Static Contracts, Static Notional, and Dynamic position sizing models, demonstrates that the

[10] The t-stat of the PnL (i.e. the fact that the average return is statistically different from zero) is equal to the annualized Sharpe ratio of the trade times the square root of the number of years that the trade is open.

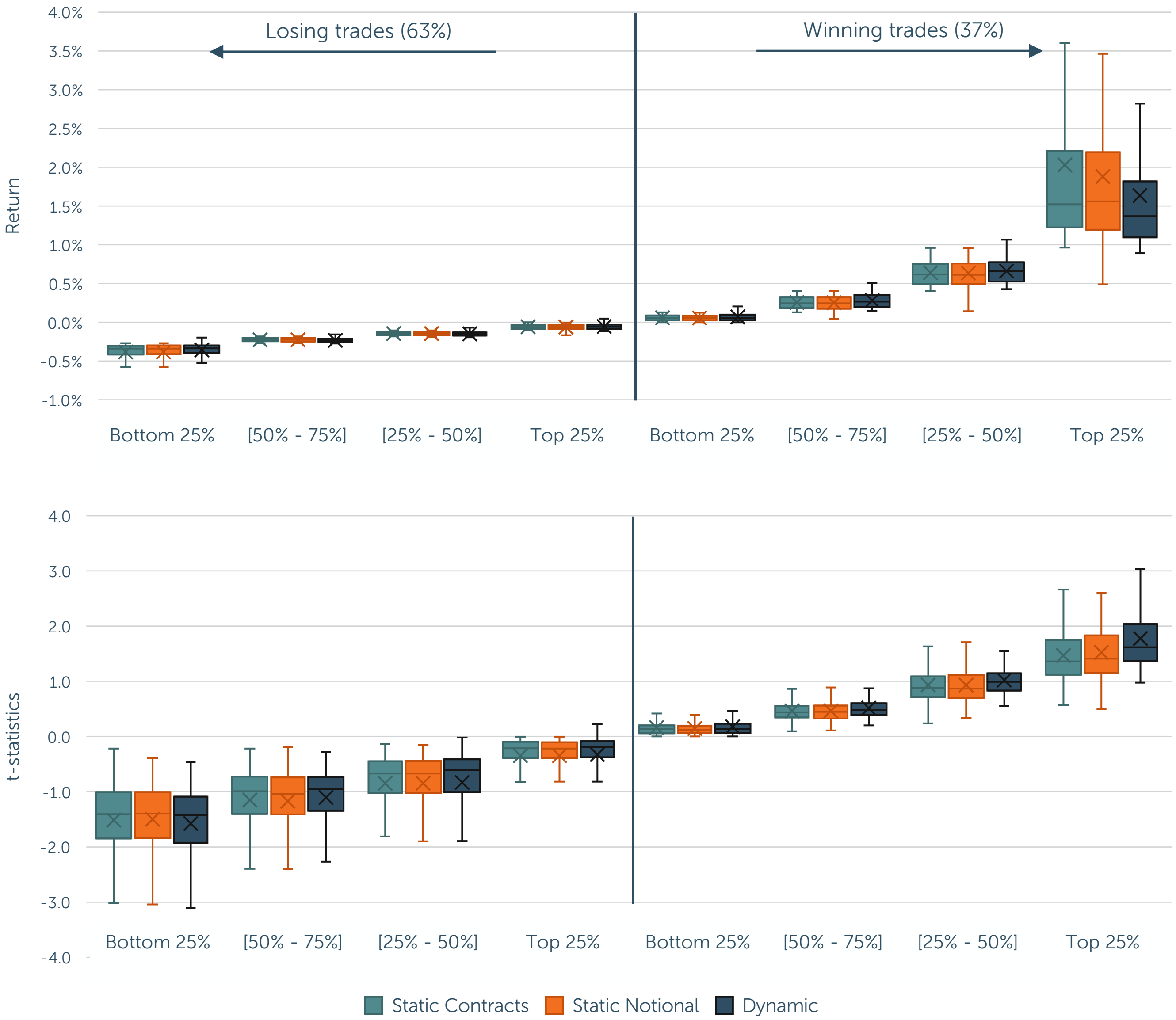


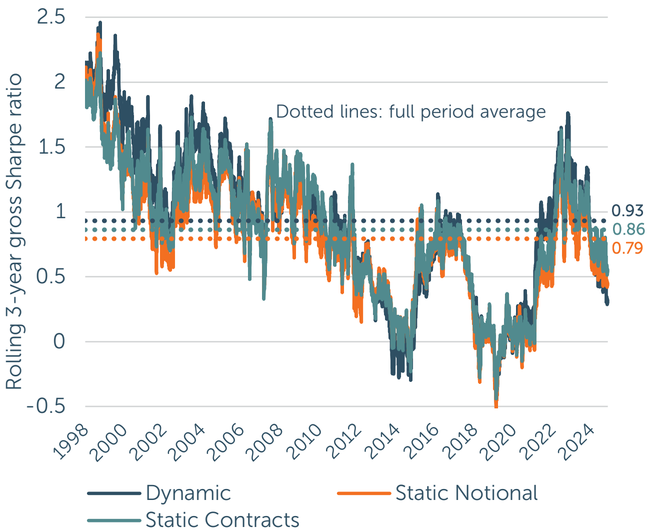
Figure 7: Distribution of gross hypothetical return (top), and corresponding t-stats (bottom) per quartile of losing (left) and winning (right) trades, for a simplified trend-following system based on three different position sizing models - Static Contracts, Static Notional and Dynamic models – as described in Figure 2. Each box is bounded by the first quartile (Q1) and third quartile (Q3), representing the interquartile range (IQR). The median is shown as a line within the box; the average by a cross. The whiskers extend to the most extreme data points that are within 1.5 times the IQR from the box edges (Q1 - 1.5 x IQR and Q3 + 1.5 x IQR). Any data points outside this range are considered outliers and are not shown here. Gross performance results are gross of any trading costs and do not reflect the deduction of investment advisory fees and other expenses, which would reduce an investor's actual return. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2. Source: Quantica Capital.

differences between the three approaches are not as significant as the cocoa example suggested.

Unsurprisingly, the Dynamic model achieves the lowest hypothetical returns of the three models with 10.5% p.a., as it tends to take profits and gradually reduce exposure during the most profitable trends when market volatility typically spikes. In contrast, both Static Contracts and Notional models do not suffer from such "constraint" and generate a higher annualized hypothetical return of 12.9% p.a. and 11.4% p.a., respectively. Such higher return however comes at the cost of higher overall risk, with an annualized volatility of 14.6% compared to 11.5% p.a. for the Dynamic model.

Model Type	Return p.a.	Volatility p.a.	Sharpe ratio p.a.	Max. Drawdown	Worst 1-day loss
Static Contracts	12.9%	14.6%	0.88	-23.2%	-6.4%
Static Notional	11.4%	14.5%	0.79	-24.4%	-8.0%
Dynamic	10.5%	11.5%	0.92	-18.4%	-5.0%

Table 1: Hypothetical annualized gross returns, volatilities, Sharpe ratios, maximum drawdown and worst 1-day loss over the period January 1995 – October 2024 for a simplified trend-following system based on three different - Static Contracts, Static Notional, and Dynamic - position sizing models as described in Figure 2. Gross performance results are gross of any trading costs and do not reflect the deduction of investment advisory fees and other expenses, which would reduce an investor's actual return. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.



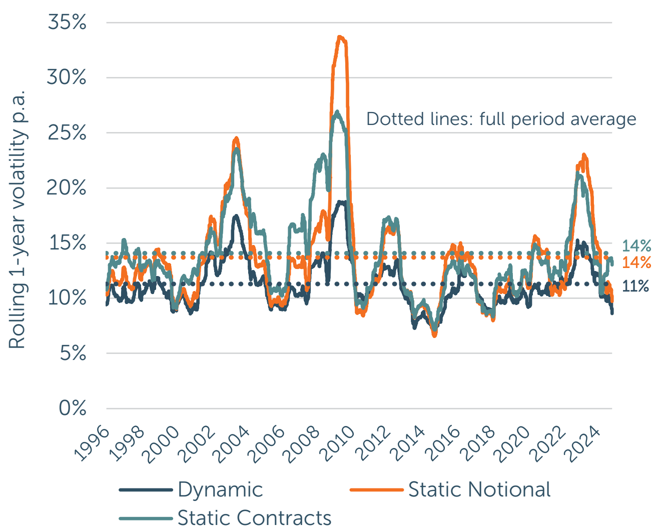


Figure 8: Comparative 3-year rolling gross hypothetical Sharpe ratios (left) and 1-year rolling annualized volatilities (right) of a simplified trend-following system based on three different - Static Contracts, Static Notional, and Dynamic - position sizing models as described in Figure 2. Period: January 1998 to October 2024 (left) and January 1996 to October 2024 (right). Gross performance results are gross of any trading costs and do not reflect the deduction of investment advisory fees and other expenses, which would reduce an investor's actual return. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

The three models lead to different overall portfolio risk exposures on different days. This difference in risk is visible in Figure 8 (right side), which shows the rolling 1-year realized volatilities for the three models. The Dynamic approach leads to a smoother volatility profile, while both Static methods display large spikes in realized volatility.

On a risk-adjusted basis, the Dynamic model records the highest Sharpe ratio (0.92) of the three models since 1995, while the Static notional model shows the lowest at 0.79. The Static Contracts model falls in the middle, with a Sharpe ratio of 0.88. Put differently, a version of the Dynamic model running bigger positions would lead to higher returns than both Static methods, for the same amount of long term risk. These differences are by no means significant, as further demonstrated by Figure 8 (left side), which presents a comparative analysis of the Sharpe ratios of the three models on a rolling three-year basis since 1998.

When limiting the comparison to the long-term simulated Sharpe ratios of the three position sizing implementations, it is challenging to make a strong case for or against any of the approaches. However, there is a significant difference that is not reflected in the aggregate strategy return figures: the potential concentration risk, where the portfolio may become overly exposed to a single position.

Figure 9 shows, for each of the three position sizing models, the evolution of the largest position, in risk terms, compared to the total portfolio risk. If the biggest position for the Dynamic model usually ranges between 5% to 15% of the total portfolio risk, both Static models display frequent, much higher spikes above 20% of portfolio total risk. 2024 is the perfect example of how a portfolio with static position sizing can become overly concentrated in a single market. The largest position in the Static Contracts model accounts for, on average, 63% of the total portfolio risk, compared to 30% for the Static Notional model and 12% for the Dynamic model. Considering these observations alongside our previous results, long term risk-adjusted returns do not indicate that a trend-following strategy using a static position sizing approach are compensated for the higher level of concentration risk of their portfolio.

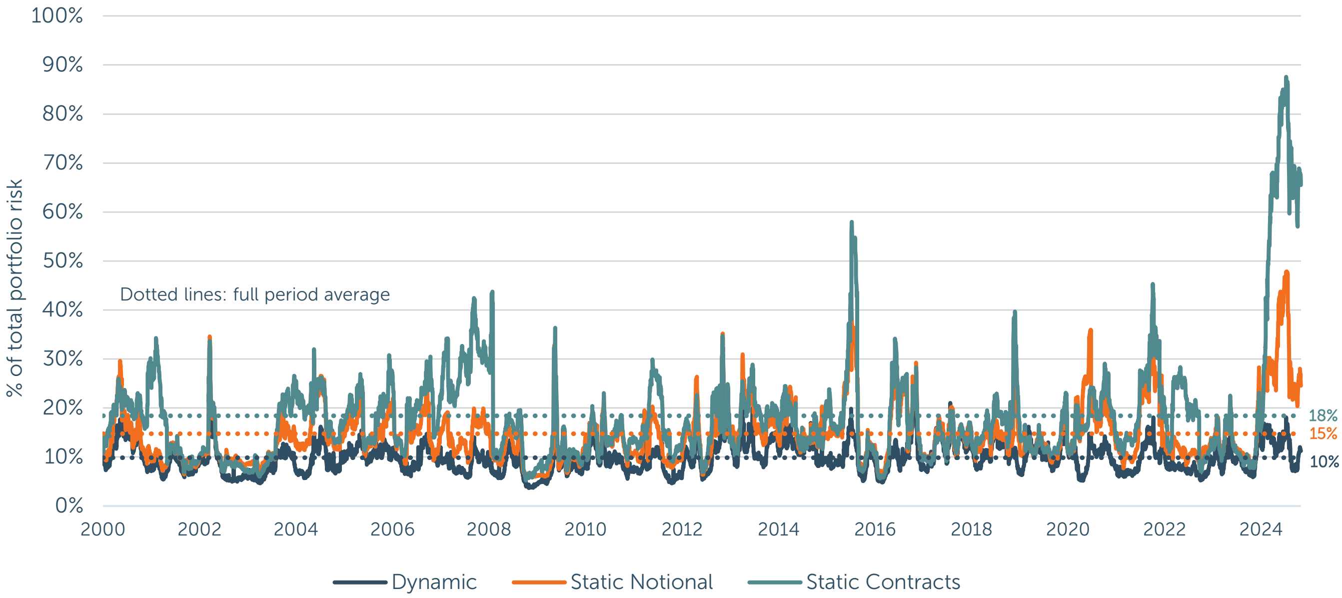


Figure 9: Hypothetical risk of the largest position as a percentage of total portfolio risk for a simplified trend-following system based on three different - Static Contracts, Static Notional, and Dynamic - position sizing models as described in Figure 2. Period: January 2000 to October 2024. Risk is defined as the daily Value-at-Risk with the parametric method at 99% confidence level, with a covariance matrix obtained using an EWMA with 0.97 decay factor. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

Dynamic volatility-based position sizing prevents a trend-following strategy from becoming over-exposed or overly concentrated in any single position from a risk perspective. This mechanism comes at a cost: it results in lower average per-trade returns, primarily because sizing exposure inversely to market volatility reduces the large right tails of the big winning trades. Paradoxically, in our simple trend-following system, taking a more concentrated approach to risk (not adjusting exposures to changing market risk) does not seem to pay off, as the risk-adjusted returns of the long-term strategy are no better than with an approach that manages individual position risk. In summary, our results suggest that a dynamic risk-based position-sizing approach offers the best tradeoff between risk management and long-term performance. While it may limit the upside of individual trades, it prevents the portfolio from becoming excessively concentrated in any single position, reducing the overall risk of suffering outlier losses. This approach does not appear to sacrifice long-term risk-adjusted returns despite its more conservative nature.

Conclusion

In this study, we show that the simulated long-term risk-adjusted performance of a representative discrete three-state medium-term trend-following signal, based on 2,750 hypothetical trades since 1995 across 50 markets, is largely unaffected by the methodology used to manage the notional and risk exposures of individual positions. Whether the initial number of contracts is kept constant or dynamically adjusted to maintain a constant notional or risk exposure throughout the trade, the overall long-term risk-adjusted strategy performance remains consistent. However, the different models may lead to significant return dispersion on a trade-by-trade basis, especially for long-duration trades that rank among the most profitable.

We have shown that the profitability of a winning trend is positively correlated to the exit-to-entry volatility ratio of the underlying market. Across all simulated trades resulting in a profit, the average volatility at the time of closing a position is 1.2 times higher than at the time of entry. Hence, dynamically adjusting a trade to maintain constant risk exposure acts as a take-profit mechanism. In fact, we have shown that for the top quartile of the most profitable trades, dynamic volatility-based position sizing does reduce a position's notional exposure by a median of 30%. Interestingly, the same observation does not hold for losing trades. For these trades, the median change in exposure due to fluctuations in market volatility across the life of a trade is around 0% across all four quartiles of losing trades.

As a result, dynamic volatility-based position sizing limits the upside that can be captured from the most profitable trends and although the approach can be viewed as a prudent risk management strategy, it provides minimal to no benefits in enhancing the return characteristics of loss-making trades, regardless of the magnitude of losses, including the largest losing trades.

Nevertheless, dynamic volatility-based position sizing does not lead to lower overall long-term risk-adjusted returns at the strategy level compared to an approach that holds a static number of contracts or maintains a constant notional exposure per trade and may benefit from the structural rise in volatility associated with the most profitable trends. At the same time, the risk of taking larger risk exposures in the largest winning trends does not appear to be rewarded in the long-term at strategy level. In this context, a dynamic volatility-based approach emerges as the more optimal solution, as it effectively manages portfolio concentration risk by avoiding excessive exposure to any single position without negatively impacting the long-term risk-adjusted returns of the strategy.

Finally, our results suggest that, over the long term and across a large number of trades and markets, the choice of model for managing individual position exposure in trend-following is a less significant driver of performance dispersion than the recent extreme cocoa trading example would imply.

Appendix

Appendix 1: Summary trade statistics for the three position sizing methodologies

			Losing trades			Winning trades		
Model Type	Total #trades	% winning trades	#trades	Average duration [business days]	Average gross return	#trades	Average duration [business days]	Average gross return
Static Contracts	2750	37%	1732	38	-0.20%	1018	192	0.75%
Static Notional	2750	37%	1736	39	-0.20%	1014	192	0.71%
Dynamic	2750	38%	1716	38	-0.20%	1034	191	0.65%

Table 2: Number of trades, average duration and gross total return per trade for the winning and losing trades generated from simulating a discrete three-state trend-following signal with three different – Static Contracts, Static Notional, and Dynamic – position sizing models as described in Figure 2. Period: January 1995 – October 2024. Gross performance results are gross of any trading costs and do not reflect the deduction of investment advisory fees and other expenses, which would reduce an investor's actual return. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

Appendix 2: Summary statistics per quartile of winning and losing trades for three position sizing methodologies

		Losing Trades				Winning Trades			
		Bottom 25%	[50% - 75%]	[25% - 50%]	Top 25%	Bottom 25%	[50% - 75%]	[25% - 50%]	Top 25%
Model Type	# trades	433	433	433	433	255	255	255	255
Static Contracts	Return	-0.38%	-0.22%	-0.14%	-0.06%	0.06%	0.26%	0.64%	2.03%
	Min. return	-1.89%	-0.27%	-0.18%	-0.11%	0.00%	0.13%	0.40%	0.96%
	Max. return	-0.27%	-0.18%	-0.11%	0.00%	0.13%	0.40%	0.96%	14.26%
	Sharpe ratio	-5.46	-4.46	-3.52	-1.42	0.45	0.65	1.05	1.33
	t-stat	-1.51	-1.15	-0.85	-0.35	0.16	0.46	0.94	1.47
	95% C.I. (t-stat)	[-1.58;-1.45]	[-1.21;-1.09]	[-0.92;-0.76]	[-0.39;-0.3]	[0.13;0.18]	[0.44;0.48]	[0.89;0.98]	[1.4;1.52]
	Length (b.d.)	33	33	36	52	92	138	213	326
Static Notional	Return	-0.38%	-0.22%	-0.15%	-0.06%	0.06%	0.25%	0.64%	1.89%
	Min. return	-2.01%	-0.27%	-0.19%	-0.11%	0.00%	0.13%	0.40%	0.96%
	Max. return	-0.27%	-0.18%	-0.11%	0.00%	0.12%	0.40%	0.96%	7.26%
	Sharpe ratio	-5.39	-4.56	-3.49	-1.43	0.44	0.66	1.04	1.36
	t-stat	-1.50	-1.17	-0.84	-0.35	0.16	0.47	0.93	1.53
	95% C.I. (t-stat)	[-1.56;-1.43]	[-1.23;-1.11]	[-0.92;-0.75]	[-0.39;-0.3]	[0.13;0.18]	[0.44;0.49]	[0.89;0.98]	[1.45;1.58]
	Length (b.d.)	33	32	37	53	91	137	214	328
Dynamic	Return	-0.36%	-0.23%	-0.15%	-0.06%	0.06%	0.27%	0.65%	1.63%
	Min. return	-0.97%	-0.27%	-0.19%	-0.11%	0.00%	0.15%	0.43%	0.89%
	Max. return	-0.27%	-0.19%	-0.11%	0.00%	0.15%	0.43%	0.89%	5.12%
	Sharpe ratio	-5.75	-4.24	-3.56	-1.44	0.45	0.70	1.17	1.57
	t-stat	-1.58	-1.11	-0.85	-0.34	0.16	0.50	1.01	1.77
	95% C.I. (t-stat)	[-1.64;-1.51]	[-1.17;-1.06]	[-0.92;-0.75]	[-0.39;-0.3]	[0.14;0.18]	[0.48;0.52]	[0.98;1.04]	[1.69;1.83]
	Length (b.d.)	31	33	36	53	89	137	201	336

Table 3: Comparative number of trades, average returns, Sharpe ratios, return t-statistics (including 95% bootstrap confidence intervals), and trade durations for each quartile of winning and losing trades generated from simulating a discrete three-state trend-following signal with three different – Static Contracts, Static Notional, and Dynamic – position sizing models as described in Figure 2. The t-stat of the returns (i.e. the fact that the average return is statistically different from zero) is equal to the annualized Sharpe ratio of the trade times the square root of the number of years that the trade is open. Period: January 1995 – October 2024. Gross performance results are gross of any trading costs and do not reflect the deduction of investment advisory fees and other expenses, which would reduce an investor's actual return. Source: Quantica Capital. HYPOTHETICAL RESULTS. PLEASE SEE IMPORTANT DISCLAIMERS ON PAGE 2.

Since 2003, Quantica Capital's mission has been to design and implement the best possible systematic trend-following investment products in highly liquid, global markets. To the benefit of our investors and all our stakeholders.

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