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QUARTERLY INSIGHTS

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The role of instrument selection in trend-following

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Executive summary

In this report, we show that instrument diversification is more important than instrument selection in the context of trend-following.

Relying on Quantica's generic trend-following strategy applied to a diversified investment universe of 83 liquid futures markets across main asset-classes, we start with highlighting how trend return opportunities across individual instruments and main asset-classes have been varying over time. We then empirically quantify the maximum theoretical trend opportunity set that can be achieved through perfect instrument selection (that means with perfect foresight) over different time periods. For that purpose, we evaluate the rolling cross-sectional dispersion of trend-following returns between profitable and unprofitable universe constituents over time. We further quantify, over different time periods, the distribution of the maximum in-sample Sharpe ratio that can be achieved by constructing a trend-following portfolio with a variable number of target constituents from 1 to the original size of the universe.

While we demonstrate a historically high and persistent opportunity set for instrument selection on an in-sample basis, we also show a lack of persistence in the cross-sectional outperformance of individual or group of instruments over time.

Indeed, the simulation of a simple out-of-sample instrument selection methodology fails to capitalize on the previously identified cross-sectional dispersion of trend opportunities over the period from 2005 to 2021.

Building an investment universe by selecting a list of instruments that have delivered superior trend-following returns in the past does not improve the expected risk-adjusted return of the same strategy that runs on a maximally diversified investment universe across the full range of available markets.

To conclude this report, we reaffirm an old known wisdom in trend-following: maximizing instrument and asset-class diversification remains the best way to capture the most profitable trends reliably and successfully across markets and time, rather than (over)-fitting a trend-following universe to the markets that historically have exhibited the best tradeable trends.

Introduction

The extent to which a financial market displays price trends which can be successfully captured by a systematic trend-following strategy varies greatly across instruments, asset-classes and time. While some individual markets and entire asset-classes, such as Fixed Income and Short-Term Interest Rates, have offered substantial return opportunities to trend-followers since the global financial crisis, other markets that are typically part of a trend follower's investment universe have proven to be far less profitable over the same period. Return contributions of most commodity and currency markets were well below their expected long-term historical averages in the decade between the aftermath of the global financial crisis and the onset of the Covid-19 pandemic. The pandemic, however, triggered a notable regime shift. Amidst a sustained rise in global inflation expectations to levels not seen in more than four decades, 2021 turned out to be one of the most challenging years for a trend-follower from a fixed-income perspective, while being at the same time one of the strongest for commodities in a long time.

Past observations of high trend-following return dispersion across instruments and asset-classes naturally lead us to ask whether it can potentially be capitalized on. Is it justified to still allocate a significant portion of a trend-follower's overall risk budget to an asset-class like Currencies that has mostly underperformed other asset-classes, and did not meaningfully contribute to overall strategy returns over an entire decade? Rather, would it not be preferable to overweight – at least punctually – instruments, groups of instruments or entire asset-classes that have historically exhibited more profitable trends? Put differently, is there a potential added value in instrument selection in trend-following by dynamically adjusting the underlying investment universe based on the profitable trending ability in the past?

To tackle these questions, we first seek to quantify from an empirical perspective how trend-following return opportunities across individual instruments and main asset-classes are varying over time. For such purpose, we rely throughout this note on Quantica's generic trend-following model[1], which is a reasonable approximation of a typical trend-following benchmark such as the SG Trend Index.

We show that on average, more than half, or 55%, of all constituents of a trend-follower's investment universe end up contributing negatively in any given year. At the same time, the upside of successfully capturing trends in the remaining 45% of profitable markets far outweighs the downside of trading unprofitable trend signals on 55% of the investment universe. In other words, the average profit generated by the 45% profitable markets is by far higher than the average loss of the unprofitable 55% of markets. We further study the dispersion of trend-following returns between profitable and unprofitable instruments over time. This allows us to get a first glimpse at the achievable *in-sample* opportunity set of dynamically selecting instruments for the purpose of trend-following.

In a second stage, we aim at quantifying, over different time periods, the distribution of the maximum in-sample Sharpe ratio that can be

[1] Quantica's generic trend-following model has been designed to closely track the SG Trend Index, an industry benchmark composed of the ten biggest trend-following programs, and can be viewed as a realistic reflection of a typical trend-following approach. Its correlation with the SG Trend Index amounts to 0.89 since 2005. In the generic trend-following approach, an instrument's weight allocation is purely a function of its trend-strength (which is a function of its past returns) and its volatility (a higher/lower volatility leading to a lower/higher exposure). The strategy is applied to a universe of 83 of the most liquid futures markets across equities, fixed-income, interest rates, currencies, and commodities. The portfolio is scaled to deliver a long-term volatility of 12% per annum.

achieved by constructing a trend-following portfolio with a variable number of target constituents from 1 to the original size of the universe. This allows us to quantify the maximum theoretical (as it requires perfect foresight) trend opportunity set that could be achieved through perfect instrument selection over different time periods.

In a final step, we look at an out-of-sample instrument selection methodology that aims at capitalizing on the previously identified cross-sectional dispersion of trend opportunities. The analysis allows us to assess whether risk-adjusted returns of a generic trend-following strategy may be improved through dynamically optimized instrument selection. Any instrument selection strategy is benchmarked against a maximally diversified investment universe including all available instruments.

The frequency and variability of profitable trends across instruments and time

The profitability of a trend-following strategy fluctuates greatly over time and differs across instruments. In Figure 1, we review the frequency of occurrence of profitable trends in any given year within our available universe of 83 liquid futures markets globally. The fraction of markets contributing positively to a generic trend-following strategy in a given calendar-year has ranged from a high of 82% in 2008 to a low of only 21% in 2012. On average, only 45% of the 83 markets have displayed profitable trends in a year during the period 2005-2021. Put differently, on average less than half of the universe constituents of a highly diversified generic trend-following strategy contribute positively to its yearly performance.

As a consequence, any trend-following strategy requires a highly right-skewed distribution of the return contributions of its individual universe

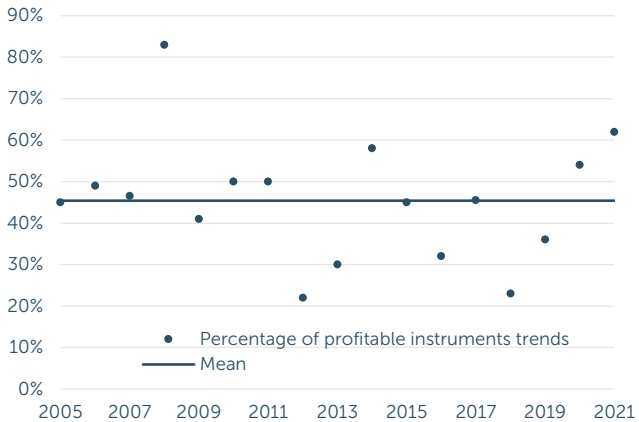

Figure 1: Percentage of 83 futures instruments exhibiting a positive generic trend-following return for each year between 2005 and 2021. Average 2005 – 2021 = 45%.

constituents to generate attractive overall returns.

As Figure 2 shows, the distribution of *calendar-year* instrument return contributions to our generic trend-following strategy is indeed highly skewed, with annual return contributions of single instruments varying between -0.6% and 2.6% over the period 2005-2021.

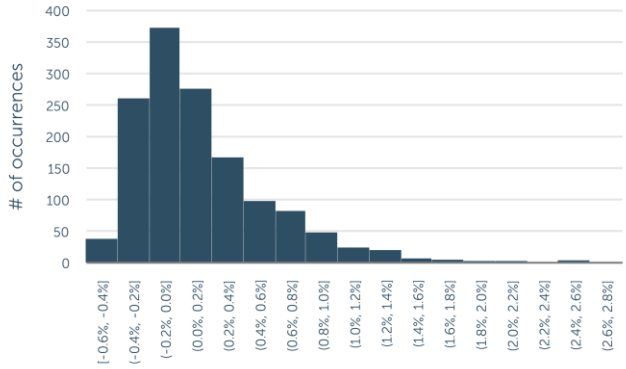

Figure 2: Distribution of calendar-year return contributions of individual universe constituents of a generic trend-following strategy between 2005 and 2021 for 83 futures markets (Number of data points: 83 constituents * 17 years).

The above pattern is synonymous with a strong variability in the profitability of trends across time and instruments and, more generally, across every major asset-class as shown in Table 1.

Since 2005, *calendar-year* realized Sharpe ratios of a trend-following strategy at asset-class level have ranged from -2.1 up to 3.2, while alternating

	Agricult-urals	Curren-cies	Energy	Equities	Fixed Income	Metals	STIR
2005	-1.4	0.3	0.5	1.9	-0.5	0.8	-0.4
2006	-0.9	-0.9	0.4	1.1	0.0	0.9	0.1
2007	1.6	0.3	1.2	0.0	-0.3	-0.3	0.1
2008	0.6	0.9	2.0	1.1	1.0	1.3	1.7
2009	-0.5	-0.1	-0.8	0.1	-1.2	0.8	0.0
2010	0.9	-0.4	-0.2	-0.7	1.3	1.5	1.3
2011	-0.8	0.3	0.6	-0.7	1.6	0.4	1.1
2012	-0.1	-1.4	-0.7	-1.0	0.1	-1.5	0.4
2013	1.1	-0.6	-1.9	0.7	-0.9	0.4	-2.1
2014	0.5	1.7	2.9	-1.2	3.2	1.0	0.9
2015	-0.6	0.7	0.6	-0.4	-0.9	0.3	0.0
2016	-0.5	-1.2	-1.6	-1.4	0.6	-0.7	-0.3
2017	-1.0	-1.5	0.3	2.0	-1.7	-0.5	-1.6
2018	-0.7	-0.7	0.4	-1.7	-0.9	-0.7	0.6
2019	-0.8	-1.0	-1.5	-0.6	1.8	1.6	1.5
2020	1.0	0.3	0.7	-0.8	0.7	1.3	2.8
2021	0.3	-0.6	1.4	0.7	-0.3	0.1	0.7

Table 1: Annualized year-on-year Sharpe ratios of applying a generic trend-following to the group of instruments composing each major asset-class.

often from positive to negative and vice versa year-over-year.

Trends rarely occur simultaneously in different asset-classes over an extended period of time. As a matter of fact, it appears that declining trend opportunities in one group of markets typically lead to new trend opportunities in other asset-classes, an observation we already outlined in our Quarterly Insights Q4'2020[2].

We further study the return dispersion between the two groups of profitable and unprofitable markets from a trend-following perspective on a calendar-year basis between 2005 and 2021. Figure 3 displays the aggregate, cumulative trend-following return contributions of these two complementary groups of universe constituents for every calendar-year since 2005.

Years like 2008 and 2014 have provided stellar trend opportunities. In 2008, only 12 instruments had a negative return contribution for the year, and this group of instruments detracted the strategy's overall performance by only -0.5%. Only two calendar-years – 2012 and 2018 – recorded an adverse trend environment as in both instances the group of profitable instruments returned less than 5%. This was insufficient to offset the negative contribution of the group of unprofitable instruments for these years.

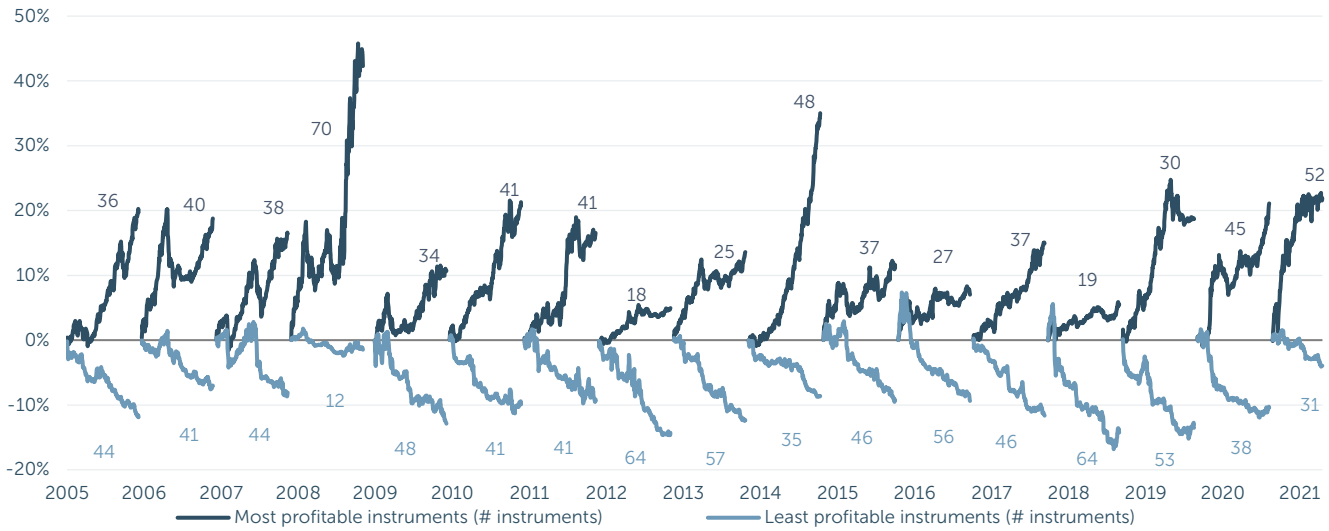

Figure 3: Cumulative aggregate return contribution and number of constituents for each year from 2005 to 2021 of the two complementary groups of profitable (instruments exhibiting a positive calendar-year return) and unprofitable (instruments exhibiting a negative calendar-year return) instruments out of a universe of 83 futures markets, by following a generic trend-following approach. Note that some of the 83 futures did not exist in early years.

[2] Quantica Capital, "A half-century of trend-following: How CTAs make money in different yield curve regimes", Quantica Quarterly Insights, December 2020

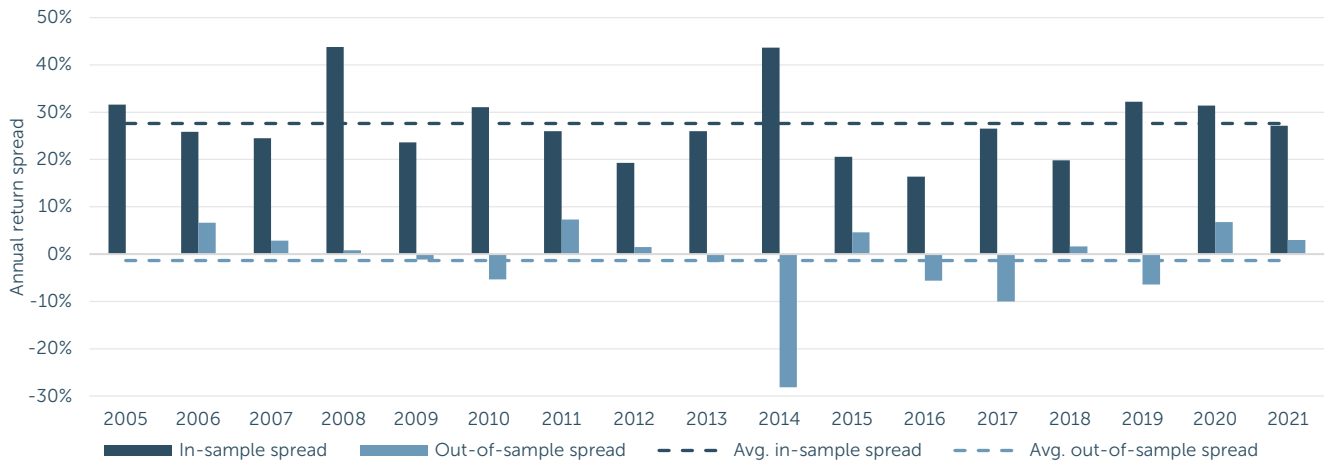

Figure 4: Annual return spread for each calendar-year from 2005 to 2021 between the two complementary groups of profitable and unprofitable instruments (in-sample) out of a universe of 83 futures markets and their out-of-sample return spread over the subsequent year.

Still, the average trend-following return spread between the profitable and unprofitable investment universe constituents has amounted to a sizable 27.6% per year, as further outlined by Figure 4.

In short, with a sufficiently diversified investment universe, the upside of successfully capturing trends in a minority of markets far outweighs the cost of trading unprofitable trend signals in the majority of the investment universe.

Figure 4 also provides a first indication about any persistence of profitable trends. It shows the one-year ahead out-of-sample return spread between the two groups of profitable and unprofitable instruments selected on an in-sample basis based on their past year-on-year returns.

The results suggest that there is no significant year-on-year persistence in the profitable trending ability of individual markets. Indeed, the average out-of-sample spread between the profitable and unprofitable instruments is on average close to 0% over the subsequent calendar-year. In the last section of this note, we generalize this analysis to look more systematically for any out-of-sample persistence in the profitable trending ability of futures markets across different time horizons.

Selecting the optimal trend-following portfolio

So far, we have grouped instruments based on their individual return contribution to a generic trend-following strategy over time. In a next step, we measure the historical performance of trend-following *portfolios* as a function of the number of selected instruments. More specifically, we search for the maximum achievable in-sample Sharpe ratio of the strategy over the entire period 2005 – 2021. This provides us with a theoretical upper bound on the risk-adjusted trend-following portfolio return that is achievable through perfect instrument selection.

Our search starts with identifying the single instrument out of 83 instruments with the highest Sharpe ratio over the entire period 2005 – 2021. In the next step, the search algorithm combines this instrument with each other instrument, evaluates the Sharpe ratio of each of these equal-weighted pairs and selects the instrument combination that produces the highest Sharpe ratio. This iterative process is repeated until the desired number of portfolio constituents is reached. Figure 5 shows the maximum in-sample Sharpe ratios that can be achieved by constructing portfolios with such methodology for a varying number of

constituents. The maximum theoretical achievable Sharpe ratio is 1.65 over the past 17 years. This is more than double of the Sharpe ratio from investing into all 83 instruments. Such Sharpe ratio would have been achieved with a portfolio of 15 instruments selected on an in-sample basis, that means with perfect foresight.

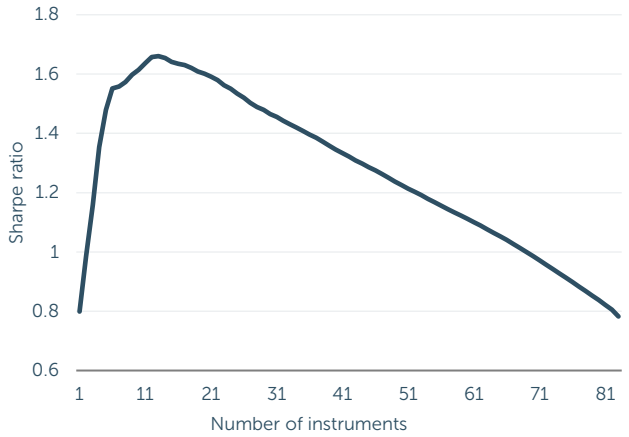

Figure 5: Maximum in-sample Sharpe ratios achieved over the period from 2005 to 2021 with optimal generic trend-following portfolios built from n out of 83 instruments.

The curve in Figure 5 represents the theoretical upper bound on the improvement in the strategy's risk-adjusted returns through optimal instrument selection for a variable number of selected instruments that would have been kept constant for the last 17 years.

The theoretical benefit of instrument selection in every year since 2005

Searching for optimal portfolios each year instead of the entire period leads to a similar conclusion. Typically, a selection of on average 5 to 15 instruments corresponds to the theoretical optimum to build the portfolio with highest in-sample Sharpe ratio for a calendar-year, as Figure 6 shows. The difference between the highest Sharpe ratio portfolio and the 83-instrument portfolio outlines the potential benefit of instrument selection with perfect foresight in any given year. 2015 for instance was the year for which instrument selection had the least impact, as the Sharpe ratio difference between the optimal portfolio and the fully diversified strategy was the lowest. In contrast, in 2014, the optimal trend-following portfolio could have lifted the Sharpe ratio from 3 to almost 6.5.

This analysis provides us with a theoretical upper bound to the potential performance improvement resulting from instrument selection. Again, the upper bound is purely theoretical as its calculation requires full knowledge of the instrument's trend-following contribution for the period under consideration.

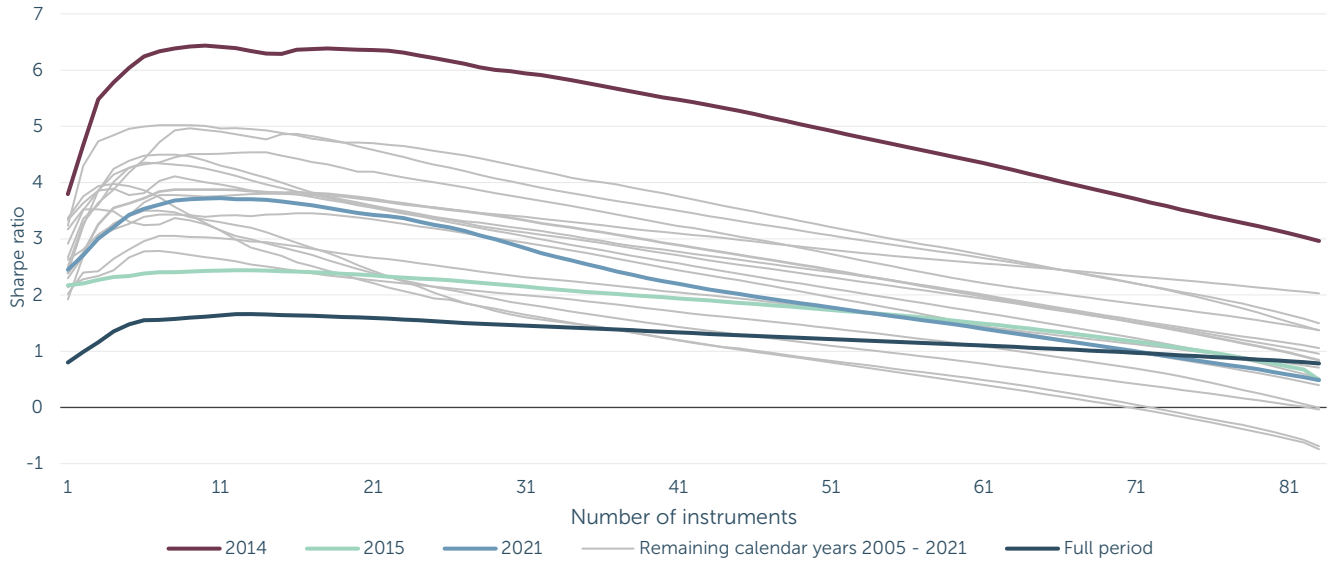

Figure 6: Maximum in-sample calendar-year Sharpe ratios of portfolios built from selecting n instruments out of 83, for each year since 2005 (the years 2014, 2015, and 2021 are specifically highlighted). As a reference the maximum in-sample Sharpe ratios over the full period 2005 – 2021 are also provided.

For illustrative purposes, we show the 20 instruments in the optimal generic trend-following portfolio for 2021 in Table 2. This portfolio would have realized an in-sample Sharpe ratio of 3.4, which is slightly below the maximum achievable theoretical Sharpe ratio of 3.7 of the optimal 9-instrument-portfolio. Interestingly, the 20 optimal instruments already show significant diversification across asset-classes. Not surprisingly, commodity instruments dominate the picture for 2021, but various equity indices, long-duration government bonds, and short-term interest rates are also included in the optimal portfolio.

Equities	Fixed Income	STIRs	Commodities
SPTSX Index	EUR BTP Italy 3yr	**Eurodollar**	**Soybean Oil**
SMI Index	EUR Schatz 2yr	Euribor	Corn
HSCEI (HK)	USD Note 2yr	**CAD STIR**	**Coffee**
	USD Treasury Ultra 10yr	AUD STIR	Lean Hogs
	AUD Treasury 10yr	**GBP STIR**	**CO2 Emissions**
			Natgas
			Iron Ore (Singapore)

Table 2: Optimal in-sample 20-instrument generic trend-following portfolio for the year 2021. The portfolio of 9 instruments highlighted in bold would have realized the maximum achievable trend-following Sharpe ratio of 3.7 for the past year.

The predictive ability of past performance in an out-of-sample setting

The in-sample results above indicate how much perfect instrument selection might improve the performance of a trend-following strategy. However, as noted before, the approach is based on perfect foresight, as it is unknown which instruments will exhibit the most profitable trends in the future. In this section we consider a realistic out-of-sample approach, where we rely solely on past performance information available at a given date to select the subset of instruments to be traded in a subsequent period. Our goal is to develop an adaptive instrument selection methodology that ideally outperforms the fully diversified generic trend-following strategy.

For that purpose, at regular time intervals (i.e., at the end of each month, quarter, or year) we search for the subset of the 83 available futures instruments that would have maximized the in-sample Sharpe ratio over the interval up to the selection date. We apply the exact same methodology to build the optimal in-sample portfolio as we did in a previous section. We only use past price information available up to the date at which we perform the instrument selection (e.g., on 31.12.2005, a selection with a 5-year lookback window relies solely on price data from 31.12.2000 to 31.12.2005). The trend-following strategy is then applied for the selected subset of instruments each subsequent day until the next instrument selection date. A schematic overview of this simulation process is provided in Figure 7.

Since the choice of the lookback window over which in-sample Sharpe ratios are calculated is not obvious a priori, we evaluate the results of the instrument selection overlay across the following 5 lookback windows: 1, 3, 5, 7, and 10 years. Similarly, we assess the performance of the instrument selection process for 3 different target portfolio sizes of 20, 40, and 60 (out of a total of 83) instruments, respectively.

As such, we are looking at 45 different configurations for the instrument selection (3

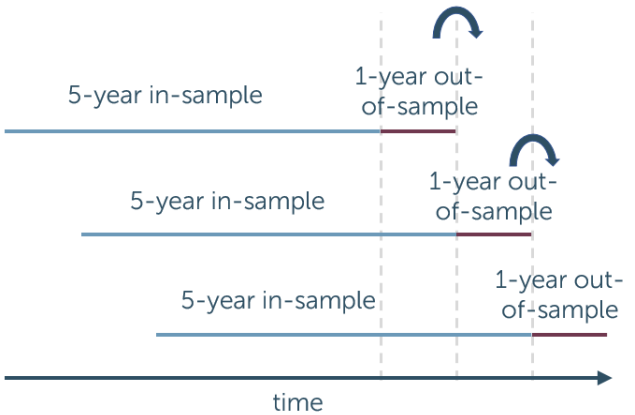

Figure 7: Illustration of a 1-year rolling out-of-sample instrument selection process relying on a 5-year lookback window to build the optimal in-sample Sharpe ratio portfolio.

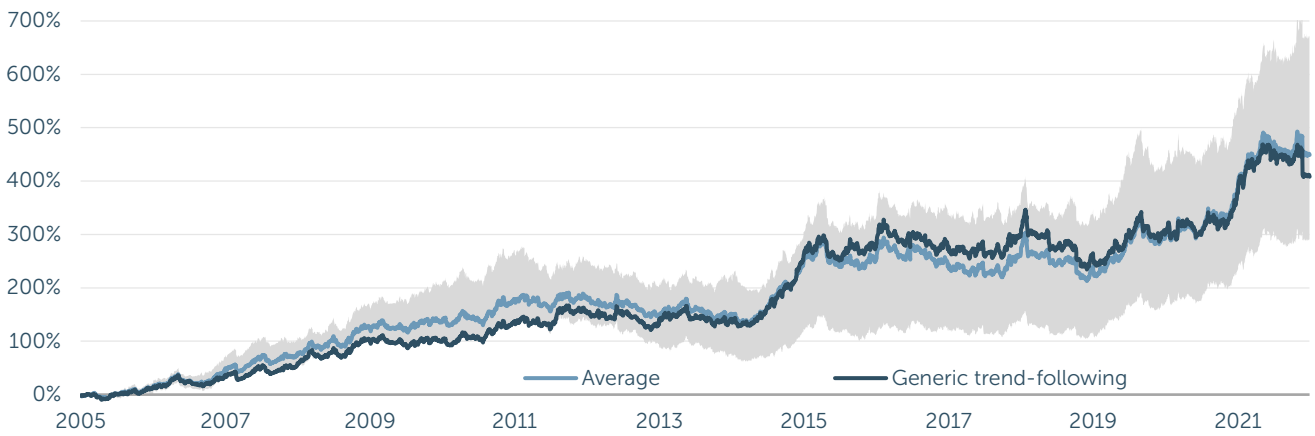

Figure 8: Historical average cumulative returns across 45 different instrument selection configurations (3 universe rebalancing frequencies, 4 lookback windows, and 3 universe sizes), including the cumulative return dispersion between the best and worst parameter configurations. The cumulative returns of the fully diversified generic trend-following strategy are provided for benchmarking purpose.

universe rebalancing frequencies, 5 lookback windows, and 3 portfolio sizes). Hence, we run a total of 3 * 5 * 3 = 45 different simulation paths from 2005 to 2021. Each of the 45 configurations is benchmarked against the reference generic trend-following approach without instrument selection.

Because we do not know a priori which parameter configuration to choose, the average return of all 45 proposed configurations is the most unbiased and representative benchmark for the instrument selection overlay. The range of historical cumulative returns for the 45 instrument selection configurations, including their average, is shown in Figure 8. As can be seen, the average of all 45 instrument selection configurations does not outperform (and tracks relatively closely) the maximally diversified benchmark trend-following strategy over the past 17 years. This means that the instrument selection can only consistently outperform the benchmark in the long-run if the "right" combination of lookback window, portfolio size and rebalancing frequency is chosen. While difficult to quantify, selecting a specific parameter configuration comes at the cost of significantly increasing the risk of overfitting.

This result is however not inconsistent with the fact that a specific instrument selection overlay may well lead to better risk-adjusted returns over shorter time periods. Remarkably, during the first 7 years of our out-of-sample simulation, between 2005 and 2011, any of the 45 configurations would have outperformed the benchmark strategy! This result reflects a stronger cross-sectional persistence in profitable trends during those years before 2011 as opposed to the more recent past. At the same time, subsequent prolonged periods of underperformance suggest that the additional complexity that comes with implementing a dynamic instrument selection overlay may not be adequately rewarded in the long run.

Finally, we provide in Table 3 a summary of the statistical significance of the risk-adjusted outperformance of different instrument selection configurations relative to the fully diversified trend-following strategy. While most parameter configurations lead to statistically insignificant lower or higher Sharpe ratios since 2005[3], it is still

[3] Table 3 confirms an earlier result of this note. Constructing an investment universe of instruments purely based on their last year's performance will unlikely outperform the fully diversified version in the subsequent year.

# instr.	1 year	3 years	5 years	7 years	10 years
20	-0.1	1.1	0.3	-1.4	0.6
30	-0.9	0.7	0.1	-0.1	0.6
40	-0.5	0.0	0.6	0.0	1.7
50	0.7	0.0	1.1	0.7	1.6
60	0.9	0.1	-0.2	0.4	2.0
70	0.1	0.6	-0.6	0.0	1.7

Table 3: t-statistics of relative risk-adjusted outperformance of different instrument selection configurations (combinations of portfolio sizes and lookback windows, assuming an annual rebalancing frequency) relative to the fully diversified trend-following strategy. A t-statistic below -2 or above 2 is indicative of statistical significance.

worth noting that a few configurations, i.e., those aiming at selecting 40 to 70 instruments out of 83 based on a rolling lookback window of 10 years appear to display more consistent and, in some cases, even statistically significant outperformance. Again, given the inherent bias that comes with parameter selection, these occurrences may well be the result of overfitting rather than an expression of superior selection ability.

In summary, when averaging across multiple instrument selection configurations in order to minimize the risk of overfitting, there is no obvious persistence in the cross-section of instrument trend-following returns in the long-run. Put differently, past trend-following returns alone are not a reliable indicator to decide whether to include or not a specific market in a trend-following portfolio. As a result, a maximally diversified portfolio appears to be the best choice to generate the best risk-adjusted returns.

Conclusion

We have highlighted the high degree of cross-sectional dispersion and variability in trend-following performance of individual markets and asset-classes over time. We have presented a simple, yet effective methodology for evaluating the maximum theoretical in-sample trend-following Sharpe ratio that can be achieved through the selection of a constituent subset of the original investment universe. Over the past 17 years, applying a generic trend-following strategy onto an optimal in-sample portfolio of 15 instruments would have generated a Sharpe ratio of 1.65, or double the Sharpe ratio of the same strategy but applied to the entire universe of 83 instruments. It represents the theoretical upper bound on the improvement in the strategy's risk-adjusted returns through instrument selection over that time period.

Additionally, we have shown that historically, a selection of on average 5 to 15 instruments represents the theoretical optimum to build the trend-following portfolio with highest in-sample Sharpe ratio in any calendar-year.

While our empirical studies have outlined a historically high trend-following opportunity set for instrument selection on an in-sample basis, we have also shown a lack of persistence in the cross-sectional outperformance of a group of instruments over time. Indeed, a pure out-of-sample dynamic instrument selection methodology, that seeks to select at regular time intervals a subset of the investment universe which displayed the highest trend-following profitability in the past, fails to reliably outperform the maximally diversified strategy, which is always running on the full universe of instruments.

Therefore, it is not possible to take advantage of the strong variability in trend-following performance across instruments and time without the benefit of hindsight, and a significant increase in model complexity. As such, an instrument's past trend-following performance is not an indication of its future trend-following performance. We conclude that a maximally diversified approach to trend-following across multiple asset-classes and instruments maximizes the likelihood of achieving the best possible long-term risk-adjusted returns with such an investment strategy.

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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