

MONTREAL EXCHANGE

Option-based signals and systematic strategies

The advent and the increased use of machine learning (ML) techniques and artificial intelligence (AI) in recent years have brought more focus to systematic strategies.

A systematic strategy is a trading or investment strategy that relies on a set of defined rules (and/or signals) to enter and exit trading positions and manage investment risk.

A systematic approach to investing is not a novel endeavour. In fact, one could argue that it has been around as long as trading in different assets has been possible. But in recent years, the flow of capital directed into quantitative strategies (which can be considered as a type of systematic strategy) combined with improved computing power which allows for the efficient and rapid backtesting of a large number of rules and signals anyone could think of, have contributed to making investors increasingly aware of these strategies. Furthermore, the democratization of some forms of systematic investing such as factor investing and the increasing coverage by mainstream and specialized media of success stories in this area¹, have contributed to attract a lot of interest.¹

In this note, we will first briefly overview some common types of systematic strategies and discuss some of their general aspects. We will then proceed to highlight how the information embedded in options can also be used to create rules and signals for building systematic strategies on their underlying asset. For this we will present a systematic strategy trading the XIU CN (iShares S&P/TSX 60 Index ETF) using an option-based signal.

What is a systematic strategy?

Wikipedia defines systematic trading strategy as “a way of defining trade goals, risk controls and rules that can make investment and trading decisions in a methodical way. Systematic trading includes both manual trading of systems, and full or partial automation using computers.”

Generally speaking, any investment strategy that is based on a set of explicit rules that the investor follows rigorously can be called a systematic strategy, as long as these rules are not modified in an arbitrary manner at the discretion of the investor.

The words systematic strategies usually bring to mind either of quantitative investing or automated trading, but those are just a subset of the big universe of systematic strategies.

For instance, a systematic strategy can be built on rules which might be based on stock or bond fundamentals. For example, a simplistic systematic strategy can be as follows:

- If price-to-book ratio falls below X and price-to-earnings ratio is below Y then buy the stock.
- If price-to-book ratio rises above Z or price-to-earnings rises above W then sell the long position.

As one can see, there is an infinite number of possible ways (i.e. rules and signals) to explore in order “systematize” any style of investing in any asset class or even to systematize the overall portfolio construction process.

1. An example is the latest book “The Man Who Solved the Market” by Gregory Zuckerman providing a look into the life story of the legendary Jim Simmons and the inner workings of Renaissance Technologies.

The key to success remains in finding and defining the rules of a strategy: what inputs are used and what conditions govern the trading.

Interestingly, even a non-systematic trader could attempt to systematize his/her approach and trading style. He/she would start by verbalizing in detail very specifically and rigorously why he/she to initiate, modify or close a trade every time he/she does so. A review of these reasons and his/her thought process will elicit – to the extent that there is a structure to it – the basis off of which he/she could identify the rules that drive his/her investment decision. Solidifying these rules and spelling them out clearly and following them rigorously would constitute their systematic strategy. That is how some of the oldest and best-known systematic strategies came to be.

Some Common Systematic Strategies

As we mentioned one can choose to build a systematic strategy for types of asset using some rules and signals based on virtually anything. Here we will just briefly highlight some types of systematic strategies. The reader might be already familiar with many of them.

One could say that at their core systematic strategies can always be thought of as being pattern recognition. In our simple example above the investor might have identified that the simultaneous drop in price-to-book ratio and price-to-earnings ratio below certain thresholds for stocks in some industries will lead to a higher probability of those stock prices rising. This can be essentially viewed as a type of pattern (not a price pattern but a pattern of behaviour in light of given conditions, in this case, the two fundamental ratios).

Technical analysis is also all about an attempt at pattern recognition and its application to investing.

Let us look at the case of Japanese candle-stick technique developed by Homma in the 18th century. The goal of this approach is explicitly to say: if you identify a specific pattern in recent days/weeks (head and shoulders, evening star, etc.) then the market action that will follow is most likely to be this given outcome (bullish, bearish with targets, etc.).

Other common strategies are those based on time of day or time of the week. Traders might uncover tendencies of prices to behave in a certain way at specific times. For instance: buy on a Friday on close if the market is up and sell Monday on the open. Or buy in the last 15 minutes if the market has rallied all day and sell the next day. A longer-term version of this type of strategy is seasonality-based strategies.

Mean reversion is another family of systematic strategies. These strategies are pattern recognition strategies to the extent that one makes assumptions about the pattern between the relationship of prices of two or more securities. For example: if the spread of price of Apple vs. Google exceeds XYZ then buy one and sell the other one.

Another well-know type of systematic strategies are those used by CTAs. CTAs rely on a wide range of indicators – traditionally most of them are trend and momentum-based indicators – to initiate and manage or close trading positions.

Given that one can virtually build an infinite number of signals and rules, there are many more approaches and styles of systematic strategies, and it is increasingly less relevant to try and categorize them given the wide spectrum of methods used. Many institutional and savvy investors go to the next step of having a systematic approach to their portfolios. Essentially, their overall portfolio is a set of systematic strategies whose weights dynamically adjust in light of their live recent performance and correlation. Suffice to say that this an area of investment management that has tremendous growth (as measured by both asset-under-management and technological and human investment) and investors would be well-advised to familiar themselves and follow its evolution.

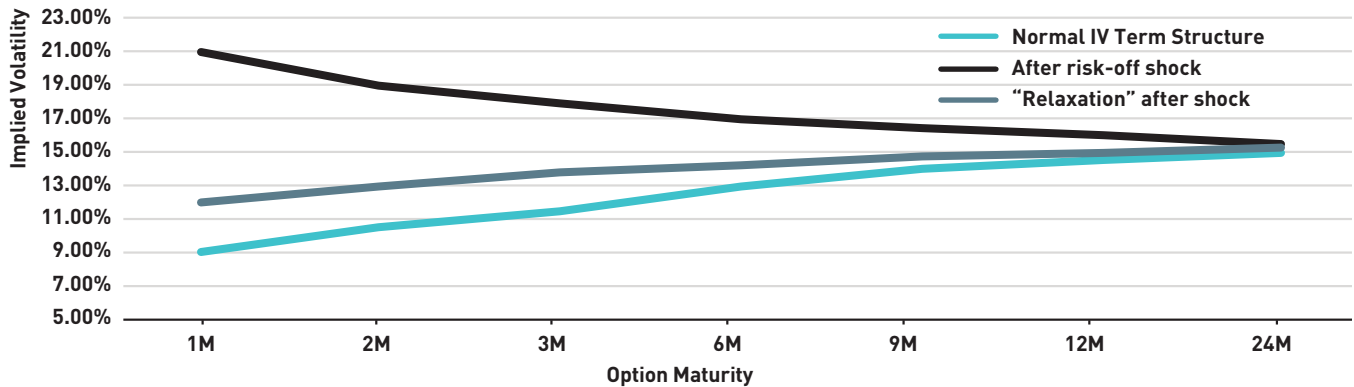
Interestingly, to date there we have seen very few discussions or publications with regard to systematic strategies which either use options or rely on option-based signals. This has been an area of specialization for LFC and has been a focus of our principals for nearly a decade and half. In what follows; we will showcase how a signal which is based on option prices can have a strong statistical significance and allow us to construct a systematic strategy on the underlying ETF. We trust the reader will get some insights into parts of our approach and methodology in building systematic strategies.

Term structure of volatility as a signal?

In times of stress (i.e. market sell-off) short term implied volatility (IV) of equity indices increases. This can be explained in part by the fact that short-term at-the-money option prices are more sensitive to abrupt moves in the price of the underlying on one hand, and the fact that usually the demand for short-term hedging increases as market turmoil arises.

While the term structure of implied volatility is upward sloping in normal times, as a result of a risk off scenario it can invert. Figure 1 highlights this phenomenon. Following an inversion of the term structure, and as the market turmoil subsides, the implied volatility “relaxes” and drops. Overtime it slowly reverts to a normal configuration (i.e. upward sloping).

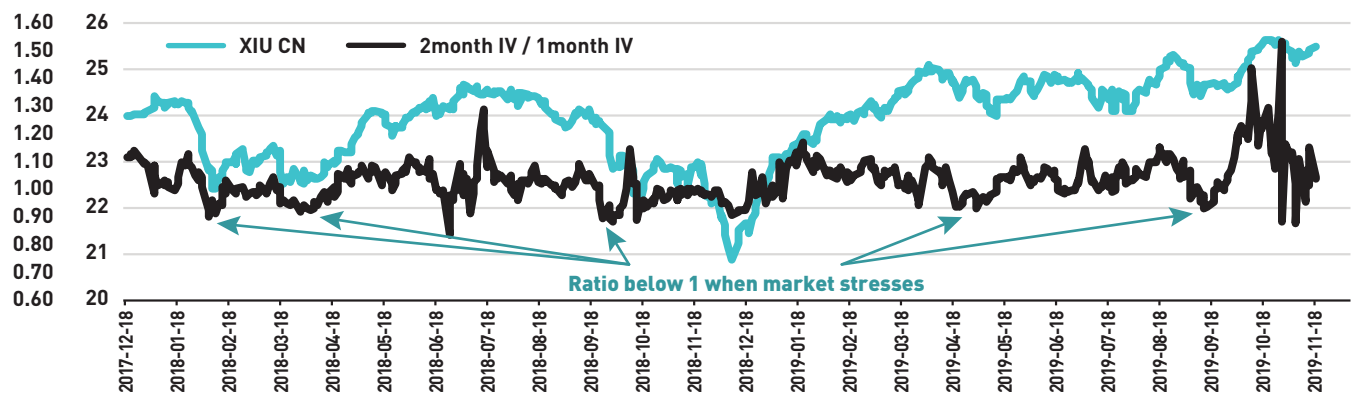
FIGURE 1
Term structure of Implied Vol.



Source: Bloomberg, Yahoo Finance, LFC calculations

Now, let us take a close look at the one-month and two-month at-the-money volatility of XIU CN. Figure 2 shows the ratio of 2-month IV over 1-month IV (in green) and the price action of XIU CN (In blue).

FIGURE 2
XIU CN price history and Ratio of 2mth/1mth IV



Source: Bloomberg, Yahoo Finance, LFC calculations

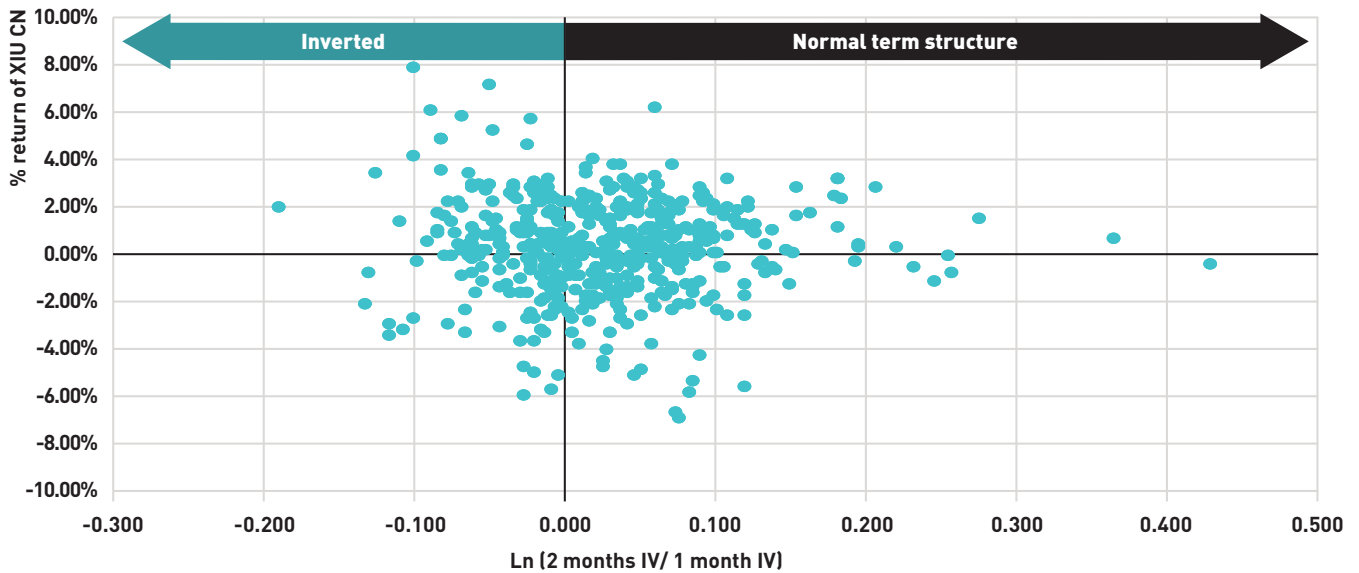
One can easily observe that in periods of risk-off when XIU CN sells off in an abrupt manner (such as Jan 2018, Oct 2018, Dec 2018 and Oct to 2019), the ratio of 2-months/ 1-month IV drops below 1 meaning that the term structure inverts.

After such episodes, usually the market turmoil subsides and either the market stabilizes or rallies. We therefore look at the inversion and its strength as a potential signal for the start of market stabilization and volatility relaxation.

The idea is to say that given that volatility has a mean reverting characteristic, if the volatility has risen enough and the curve has inverted “enough” the probability of a relaxation and return to normal rises.

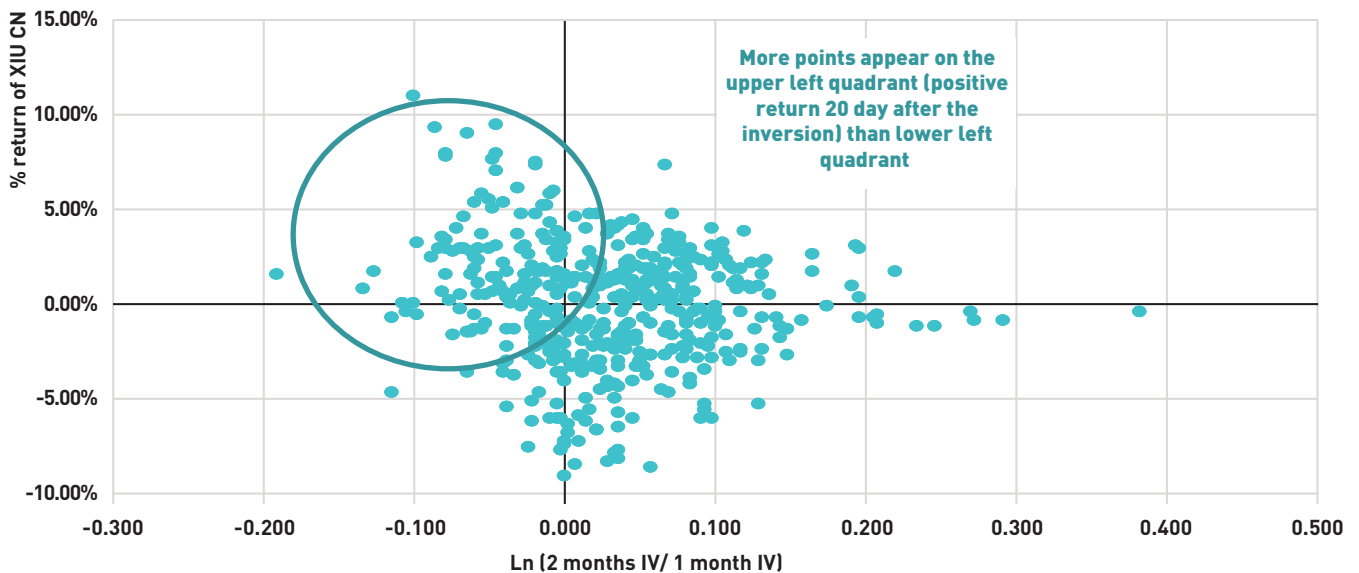
To see in fact if the inversion has a predictive power, we look at the relationship between $\ln(2\text{mths IV} - 1\text{month IV})$ versus the price performance of XIU CN in the next 10, 20 and 30 business days.

FIGURE 3
XIU CN 10D performance vs. steepness of TS



Source: Bloomberg, Yahoo Finance, LFC calculations

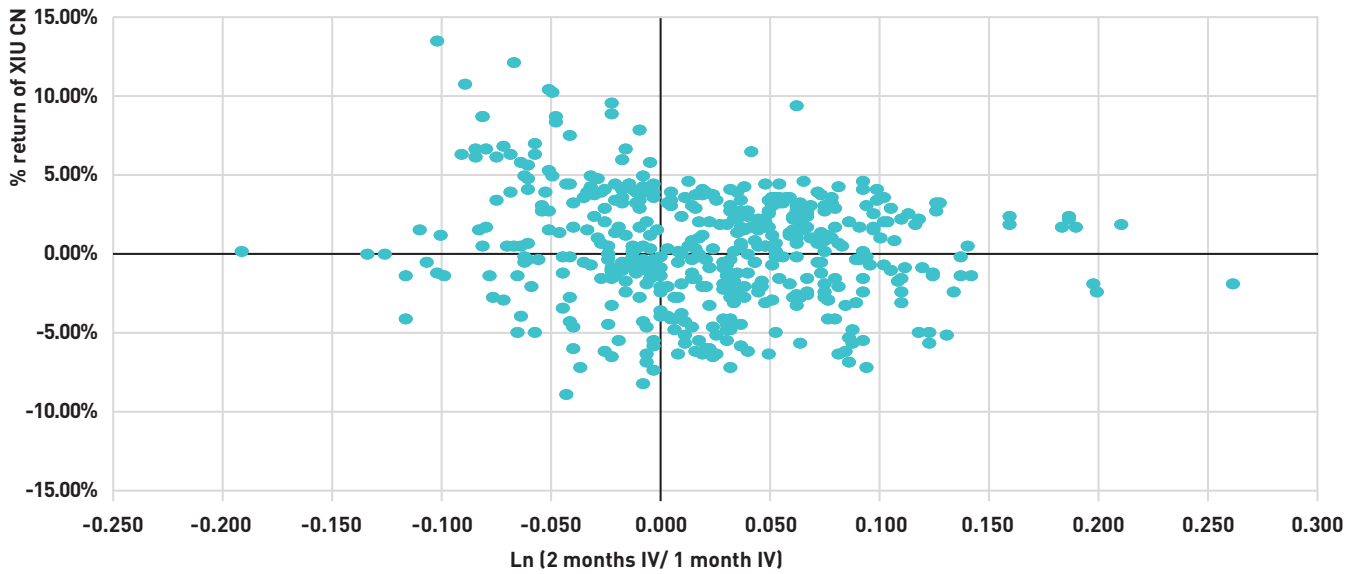
FIGURE 4
XIU CN 20D performance vs. steepness of TS



Source: Bloomberg, Yahoo Finance, LFC calculations

On the x-axis the negative values represent the inversion of the term structure (i.e. ratio of 2 months IV over 1 month IV is less than 1.00), while positive values of x correspond to an upward sloping term structure curve. The upper left quadrant corresponds to situations when for an inverted term structure, the subsequent 10 (20 or 30) day return of XIU CN is positive. The lower left quadrant corresponds to situations when for an inverted term structure, the subsequent 10 (20 or 30) day return of XIU CN is negative.

FIGURE 5
XIU CN 30D performance vs. steepness of TS



Source: Bloomberg, Yahoo Finance, LFC calculations

Even visually the reader can notice that at least for the case of the charts for 20 and 30-day returns, there are more points in the upper left quadrant than the lower left quadrant. This means that when the curve inverts the subsequent 20 and 30-day returns are more likely to be positive than negative.

We take a closer look at these quadrants and relevant return statistics after an inversion of the implied volatility term structure as a function of the severity of the inversion.

Tables 1 to 4 show the instances in which 10 (20 or 30) day returns were positive versus negative for an inversion ranging from 0 to 4% (in 1% increments) respectively.

TABLE 1
Inverted by 0% and more

After # days	10D	20D	30D
Positive return	101	103	99
Total cases	171	171	171
% of + returns	59%	60%	58%

Source: Bloomberg, Yahoo Finance, LFC calculations

TABLE 2
Inverted by 2% and more

After # days	10D	20D	30D
Positive return	63	72	65
Total cases	100	100	100
% of + returns	63%	72%	65%

Source: Bloomberg, Yahoo Finance, LFC calculations

TABLE 3
Inverted by 3% and more

After # days	10D	20D	30D
Positive return	51	60	52
Total cases	81	81	81
% of + returns	63%	74%	64%

Source: Bloomberg, Yahoo Finance, LFC calculations

TABLE 4
Inverted by 4% and more

After # days	10D	20D	30D
Positive return	46	52	45
Total cases	66	66	66
% of + returns	70%	79%	68%

Source: Bloomberg, Yahoo Finance, LFC calculations

Observations and take aways

- The 10, 20, 30-day returns of XIU CN after an inversion of term structure of IV are more often positive than negative.
- The higher the inversion the more likely it is that the subsequent return of the ETF over a 10, 20, 30-day period is positive
- For the period we have analyzed the return over the 20 days following the inversion appears to be most likely to be positive, when compared to the 10 and 30-day returns.

A trading strategy based on the term structure of volatility

In light of the above observation and the fact that following an inversion of the term structure XIU CN are more likely to be positive than negative, we design a trading strategy which uses the inversion of term structure as a signal as follows:

- Buy XIU CN (end-of-day) when the term structure of IV inverts; as measured by $\ln(2\text{mths IV} - 1\text{month IV})$.
- Sell the position after 20 business days.

Table 5 shows the results of the backtest for this strategy for a 2-year period (from December 18, 2017, to December 17, 2019) and for different levels of inversion of the term structure from 0% (i.e. flat term structure) to 4% inversion (i.e. 1-month IV is approx. 4% higher than 2-month IV).

TABLE 5

Comparing the characteristic of trading strategies on XIU CN using term structure of IV as a signal (20-day holding) vs. XIU CN

XIU CN	Inversion level	0%	-1%	-2%	-3%	-4%
3.2%	Annual Return	8.4%	6.1%	9.0%	9.2%	7.4%
9.5%	Volatility	9.1%	9.1%	9.0%	8.9%	9.0%
-8.6%	Drawdown	-6.8%	-6.8%	-3.6%	-2.3%	-2.3%
0.34	Info Ratio	0.92	0.67	1.00	1.04	0.82
N/A	# of trades	18	16	13	12	10

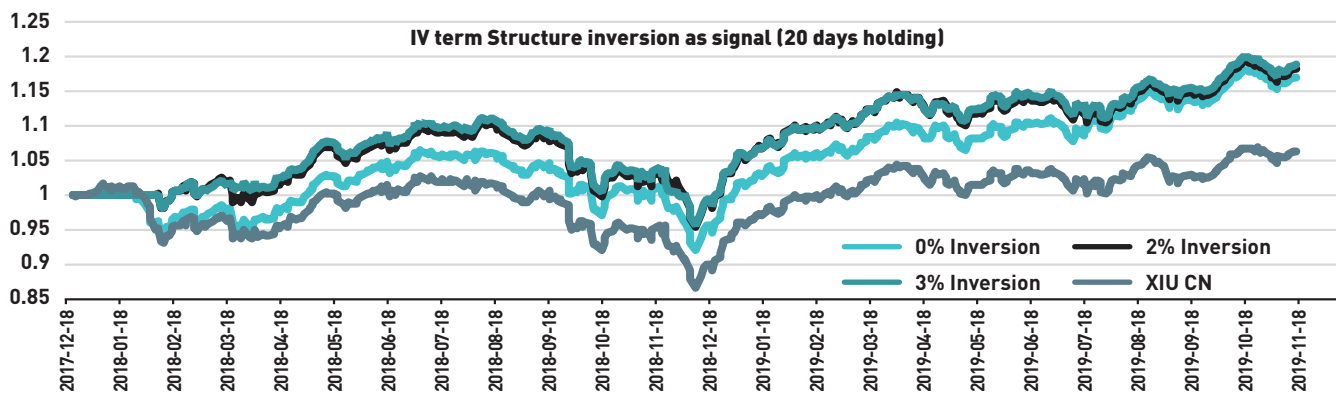
Source: Bloomberg, Yahoo Finance, LFC calculations

For all levels of inversion, using the option-based signal drastically improves all of the statistics when compared to a passive investment in XIU CN.

- In particular when trades are initiated for an inversion of 2 and 3% of IV term structure, the annual returns are noticeably higher than a passive investment (resp. 9% and 9.2% vs. 3.2%)
- Additionally, the risk-adjusted return as measured by the Information Ratio (IR) nearly triples from 0.34 to resp. 1 and 1.04.
- Finally, the signal-based strategy exhibits a drawdown which is about only half or less that of a passive investment in XIU CN. Another attractive characteristic.

FIGURE 6

Comparison of a passive investment in XIU CN vs. the signal-based strategy



Source: Bloomberg, Yahoo Finance, LFC calculations

Some considerations:

- As one would expect the higher the level of inversion the less often one has the opportunity to enter a trade (from 18 trades for a flat curve to 10 trades for 4% inversion).
- It is also important to note that implied volatility is a calculated value which relies both on a model and other inputs such as interest rates and dividend. In the present case we have used Bloomberg data for implied volatility.
- Making inferences about the viability of a strategy based on a 2-year period and around 15 trades might not fully address the robustness of the signal, but without getting into further detail, we can highlight that this signal is viable once the study is expanded over longer and different periods, the reader can verify this at their leisure but also try and test the viability of this signal and methodology for other equity indices, which might highlight other interesting findings.

- Our backtest does not account for transaction costs, but given that the TMX offers a market-on-close facility (MOC) guaranteeing the closing price for XIU CN and other eligible stocks and ETFs, the main cost incurred by the investor to implement a similar strategy is that of trading and settlement cost which for most major institutions can be expected to be equal or less than 5 bps per trade. As such, the backtest results remain relevant (for 18 initiating trades and the corresponding closing trades, the order of magnitude of total transaction costs is around 1.8% which remains well below the nearly 6% return improvement we have observed).

We conclude that the IV term structure inversion signal is a viable signal to build a systematic trading strategy. It is also to be noted that we did not seek to do any data fitting or ex-post adjustments, we simply made a hypothesis and tested it and as such we avoid many complications and pitfalls of other types of approaches in backtesting.

Futures & options and the related data (price, volume or open interest) as well as implied information (implied volatilities and the volatility surface) can be the source of many interesting signals upon which systematic strategies can be built or be improved.

Important note: Notwithstanding all the above, investors must always remain alert and aware of the risks associated with any dynamic trading strategies and must be cognizant of the fact and reminded that past characteristics and behaviour of markets, price patterns which constitutes the building blocks of systematic strategies will not necessarily be the same in the future. Past performance of any strategy is not a guarantee of future performance.



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In addition to niche derivatives strategies, LFC also provides risk-management, hedging and overlay advisory services to family offices, institutional investor and businesses.

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