Futures "Pain Trade" Open Interest Monitor:

Methodology & Backtests

Introduction

We have developed a trading model that estimates how investors are positioned across a wide array of futures markets. The model incorporates daily exchange data on open interest changes and price changes to estimate the types of positioning changes that have motivated recent movements in futures prices. It then associates these positioning changes with specific price levels. We assess a rolling 30 trading day history of these position changes and price levels. The goal is that by associating recent changes in positioning with specific price levels, we can identify markets where there are asymmetric risks for future positioning changes and, therefore, for future price changes. Each day, we publish the output of our model in a series of charts titled the "Futures 'Pain Trade' Open Interest Monitor."

Three key features of our "Pain Trade" model are 1) it incorporates only data that are publicly and readily available, 2) it is consistent and applicable across futures markets in different regions and asset classes, and 3) it relies on three relatively intuitive assumptions. We used the outputs of our model to create daily trading indicators and backtested the performance of these indicators across more than 50 futures markets, utilizing more than 10 years of daily data. Based on the results, we believe that the futures "Pain Trade" model is additive to a futures trading strategy.

Methodology

FIRST ASSUMPTION

Each day we input two pieces of information for each futures contract in our "Pain Trade" model—the direction of the change in price in the contract, and the direction of the change in open interest. The first assumption in our "Pain Trade" model is that a change in futures open interest reveals the type of change in positioning that, on the margin, motivated a given change in price in a futures contract. For example, suppose that one day, there were an exactly equal number of investors looking to establish new longs in a futures contract as there were investors looking to establish new shorts. If these investors were all equally motivated, we would expect them to meet exactly in the middle on price—at the end of the day we would see no change in price, but would see an increase in open interest reflecting the new longs and new shorts that had been established. If, however, price as well as open interest had increased on the day, we would assume that there had been greater demand from the investors looking to establish new longs than from the investors looking to establish new shorts. On the margin, we would hold that it was demand from new longs that motivated the increase in price that we observed. To some extent, the new shorts that met the new longs were liquidity providers, offering futures supply in exchange for an expected risk-premium (and may have even hedged this exposure in another instrument).

The below two-by-two grid shows the four possible scenarios we observe based on these two model inputs.

Exhibit 1

If, on a given day, price increased and open interest increased, we assume that the increase in open interest was motivated, on the margin, by new longs opening positions. Conversely, if price decreased and open interest decreased, we assume that the decrease in price was motivated, on the margin, by existing longs selling out of their positions. If price decreased on a given day and open interest increased, we assume that the decrease in price was motivated, on the margin, by new shorts establishing positions. Finally, if price increased but open interest decreased, we assume that the increase in price was motivated, on the margin, by existing shorts covering their positions.

Based on our above reasoning that a change in price is a reflection of the imbalance in the demand from buyers vs. sellers, in our trading model we scale each day's open interest change by the magnitude of the change in price on that day (as measured by the z-score of the price change). If we observed a large increase in open interest on a given day and a large increase in price, we would have more conviction that the increase in open interest was characterized by new longs entering the market than we would if price saw a very small increase on the day (suggesting that new shorts were nearly as motivated as longs to establish new positions).

SECOND ASSUMPTION

The second assumption in our "Pain Trade" trading model is that we associate the change in open interest each day with the closing price of the futures.[1] Exchange open interest data are calculated after the close each day, after all of the trades have been settled and the outstanding positions calculated across all accounts. Unfortunately, it is not possible to see open interest changes intraday. Certainly, not all (or even most) trades that result in open interest changes occur at the closing price. We think, however, that using the daily closing price as an indication of the level at which positions were established or taken off is largely reasonable.

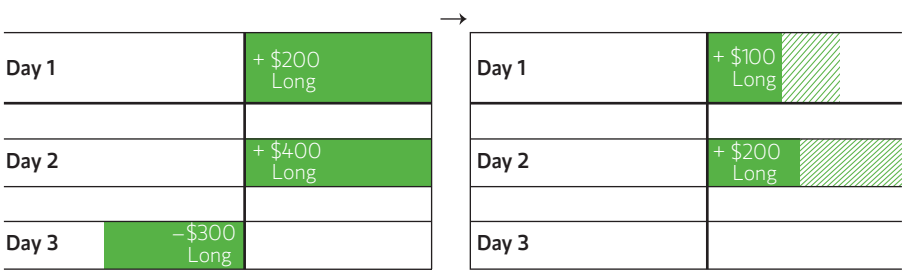
THIRD ASSUMPTION

Finally, our third assumption pertains to days when we estimate that open interest was taken off, or existing positions were closed. On days when we estimate, for example, that existing longs were taken off, we look back over prior days in our 30-day window on which longs were added, and assume that a proportional amount of the open positions initiated on those days came off.

For example, suppose on the first day in our window we estimated that $200 million of new longs were added at a given price point, and on the second day we estimated that $400 million of new longs were added at another price point, for a total of $600 million in new longs added. If on the third day we observed that $300 million of existing longs were taken off, we would assume that 50% of the existing longs at each of the two prior price points had been taken off. We would now assume that $100 million of new longs were outstanding at the first price point, and $200 million of new longs were outstanding at the second price point.

It might hold that a decrease in open interest is more likely to come from older positions vs. newer positions, or positions that are more "underwater" vs. positions that are more "in the money." We think, however, that proportionately removing open interest from prior days in our 30-day window is a reasonable base case assumption. This also highlights one of the reasons why we utilize a (rather short-term) rolling 30 trading day window in our model. Given our assumptions, we naturally have less conviction in our positioning estimates the farther back we look and, at some point, these estimates become an exercise in diminishing marginal returns. A 30 trading day, or 6-week, window seems to strike a reasonable balance between these factors.

Exhibit 2



"PAIN TRADE" CHARTS

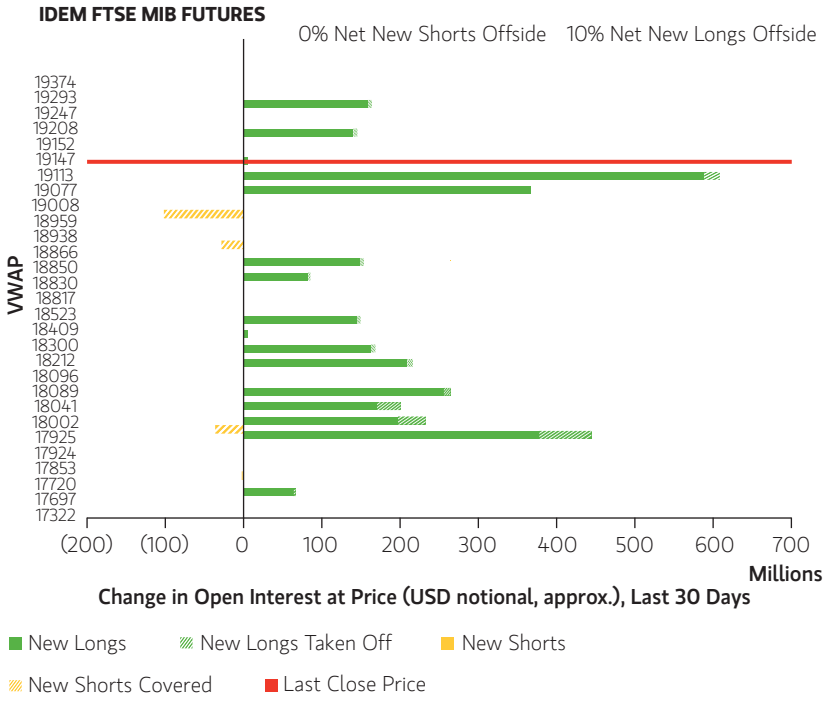
The chart in Exhibit 3 shows how we would estimate that investors are positioned in FTSE MIB Italian Equity Index futures as of Wednesday, October 30, 2013, based on the 3 assumptions in our "Pain Trade" model. It reflects our estimates of the types of open interest changes that have motivated price changes in the contract over the last 30 trading days, and the price points at which they were established or taken off. The solid green bars represent the new longs that we estimate have been added at different price points, and the solid yellow bars represent the new shorts that we estimate have been added at different price points. The striped portions of

1 In our daily "Futures 'Pain Trade' Open Interest Monitor," we associate the change in open interest each day with the VWAP of the futures. We are limited, however, in the availability of historical intraday price and volume data with which to calculate daily futures VWAPs. Accordingly, given the length of history we incorporated in our backtests, we associated the daily open interest changes with the futures closes.

the green and yellow bars represent the new positions, established over the past 30 trading days, that we estimate have since come off. The prices on the y-axis represent the closing prices that we have observed over the last 30 trading days in descending order of price. Finally, the red line is the most recent closing price in the contract, so this is effectively the "current" price point against which we are comparing all of the prior open interest changes when we assess which positions are "offside" vs. "onside," and where we might potentially observe "pain trades."

where a significant amount of positions are currently (or may potentially become) caught "offside," or are losing money. For longs, or the green bars in the chart, these would be positions that were established at prices above the most recent price point (the two uppermost green bars in Exhibit 3). For shorts, these would be positions, or the yellow bars, that were established at prices below the most recent price point, or the red line. The idea behind a "pain trade" is that having a significant amount of positions that are losing money (e.g., a significant amount of longs that were established at

Exhibit 3



The location of the red line relative to other price points in Exhibit 3 indicates that the current price of this future is near the top end of the range that we've observed over the past 30 trading days. The open interest changes in FTSE MIB futures over the past 30 days have been dominated by what we're estimating have been new longs being established, with very small shorts being covered.

What we're trying to measure in our "Pain Trade" monitor are contracts

prices above the most recent price point) could mean that investors will quickly begin to exit out of those positions as prices continue to move against them. An example of this is a short squeeze lending momentum to an initial rally in prices.

The notion of a "pain trade" necessarily assumes that investors are motivated differently by losing money than by making money or, more specifically, that an investor is more likely to exit a trade as a result of losing money, than as a result of having made money. In our backtests, we've looked at both the ability of the amount of longs and shorts added in a contract to predict future changes in price, as well as whether estimating the amount of positions that are currently or potentially "offside" is additive to this process. At a portfolio level, the results suggest that informing trades by an indication of "offside" positions is additive.

A NOTE ON ROLLS

We make two adjustments in our "Pain Trade" model to try to isolate the impact of the calendar roll on futures open interest. The first is that we look at combined open interest changes in the first two nearby futures for most financial futures (for commodity futures, and financial futures with monthly rolls, we look at open interest changes across the entire curve). This ensures that open interest that is merely rolling from the expiring nearby futures contract to the next out futures contract is not described as a change in open interest. Additionally, for many futures contracts, there is a natural increase in open interest during the roll period, as dealers and arbitrageurs establish positions in the calendar spread to facilitate the natural roll demand from investors in exchange for a risk-premium. To isolate this increase in open interest during the roll, we compare daily changes in open interest during the active days of the roll to the average historical changes in open interest over those days of the roll period, to identify the amount by which the change in open interest differs from the average change in open interest on a given day in the roll period. This helps us isolate the incremental change in open interest on that day that would presumably have motivated the change in price on that day.

ADDITIONAL CONSIDERATIONS

Finally, this methodology does not identify open interest changes that are part of spread trades, or curve trades, or

hedges. For example, a position that we identify as "offside" in a given futures contract may in fact be part of a larger spread trade, and while one leg of the trade might be "offside," the spread trade as a whole may be profitable. We would expect that the holder of this spread trade would be motivated differently by one leg making or losing money than would the holder of just one leg of the spread.

Backtest Results

INDICATORS

We constructed three trading indicators based on the daily metrics in our "Pain Trade Monitor." The first indicator looks at the amount of new longs vs. new shorts that we estimate have been added in a contract over the previous 30 trading days, as a percent of total open interest. A large amount of new longs vs. shorts added over the past 30 days would cause us to anticipate that the futures price would be more likely to decrease rather than increase on the subsequent day; a large amount of new shorts vs. new longs added would cause us to anticipate that the futures price would be more likely to increase rather than decrease. We calculate a z-score of this metric (and the two other metrics outlined below) based on the rolling 1-year standard deviation of these observations. We use this z-score to create a signal, where we implement 100% of our maximum position size when our indicator realizes a z-score greater than or equal to 2 or less than or equal to -2.

Our second indicator follows the same methodology, except that rather than look at just the new longs vs. new shorts that have been added, we look at the P/L of new longs vs. new shorts that is currently caught "offside" relative to the most recent price. If we estimate that there is a significant amount of negative P/L from longs that are currently "offside" vs. shorts that are currently "offside," this will cause us to anticipate that the futures price will be more likely to decrease than increase as "offside" longs sell out of these losing positions. If we estimate that there is a significant amount of negative P/L from shorts that are currently "offside" vs. longs that are currently "offside," this will cause us to anticipate that the futures price will be more likely to increase rather than decrease as "offside" shorts cover these losing positions.

The third indicator also gauges "offside" P/L, but rather than look at the amount of P/L that is currently caught "offside," it estimates the amount of P/L from longs vs. shorts that would become caught "offside" if there were a 2 standard deviation move in price in either direction of the current price level. Essentially, the third indicator anticipates when significant positions could become caught "offside," and identifies these instances of asymmetric price risk. The indicator captures both the additional P/L that would be lost from current "offside" positions in a further price move, as well as the P/L that would be lost from current "onside" positions that would become caught "offside" in a 2 standard deviation price move. The chart in Exhibit 4 shows our trading signal for this third indicator for CBOT 10-Year US Treasury Note futures.

One additional consideration in constructing and backtesting these indicators is that there is a delay in when the open interest data, which we use to create our signals, are reported. A given day's change in open interest is typically reported by the exchange the following morning. In our backtests, we have conservatively assumed that any trade would be placed on the close the day that the open interest data are reported, and would earn the return for the subsequent one day. In other words, we assume that Monday's open interest changes are used to place trades on Wednesday's price return.

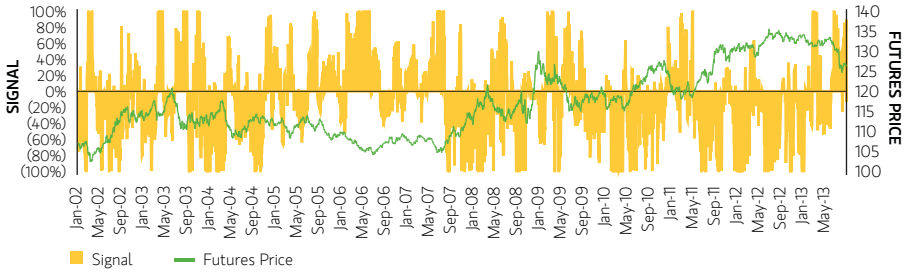
BACKTESTS

We backtested our three trading indicators across 53 different futures contracts (22 developed and emerging market equity index futures, 12 bond futures, 7 foreign exchange futures, and 12 commodity futures). Our backtests incorporated daily data since the start of 2000. For each indicator, we tested three different applications — 1) using a signal informed by long and short positioning to place trades when either longs or shorts were at extremes (a long/short strategy), 2) using a signal informed by long and short positioning to place trades when only shorts were at extremes (a long only strategy), and 3) using a signal informed by only short positioning to place trades when shorts were at extremes (a long only strategy).

We think it intuitively makes sense that the holders of long vs. short futures positions might be different, and might be differently motivated. As compared to long futures holders, short futures holders might be funds that are more keenly sensitive to short-term losses (and

Exhibit 4

Signal (P/L Caught "Offside" From Longs vs. Shorts in 2 standard deviation price move) vs. Futures Price, CBOT 10-Year US Treasury Note Futures



thus exhibit "pain trade-like" tendencies); long holders are often more institutional holders of assets, and might be less motivated by temporary gains and losses. Even in commodity futures, where short holders are often producers who are hedging physical commodities, there is evidence of producers covering short hedges when prices rally and these losing hedges put pressure on daily cash flows.

Finally, we tested applying each indicator at various signal strengths—placing a trade each day at every signal strength (scaled by the strength of the signal, with a max position when the indicator was beyond +/- 2 z-scores), and placing a trade only when the indicator was beyond +/- 1, +/- 1.5, and +/- 2 z-scores.

RESULTS

On average, across all 53 markets, we found that informing our signal by long and short positioning, and placing trades only when short positioning was at extremes, generated the greatest return per unit of risk. We found that a strategy informed by short positioning relative to long positioning added considerably more value than one informed by short positioning alone (even short positioning relative to total open interest). We did not find that a long/short strategy implemented when both short positioning and long positioning was at extremes resulted, on average, in Sharpe ratios above zero. Finally, we found that the return per unit of risk was greatest when our indicators generated signals beyond 2 z-scores.

The below table shows the average Sharpe ratios of each of our 3 indicators (each informed by long and short positioning, and placing trades when short positioning is at extremes) when their signals were beyond 2 z-scores. These Sharpe ratios reflect the historical return to risk ratios of our three indicators on days they would have generated trades (when their signals were beyond 2 z-scores) and exclude those days when our indicators would not have taken risk.[2] The average Sharpe ratios were constructed by weighting the indicator Sharpe ratios realized across futures contracts by the number of days the indicator would have generated trades in each contract (the number of days the signal was beyond 2 z-scores—this also helps adjust for the fact that some of these futures have shorter histories, so had fewer observations to include in a Sharpe ratio measurement). Since our strategies place only long trades when short positioning is at extremes, we have included as a point of comparison the Sharpe ratios of passively holding the underlying futures long over this entire period.

We found that, on average, the trades generated by our third indicator (shorts' P/L "offside" if 2 standard deviation price move) had a more than 50% greater return per unit of risk than passively holding a contract long over the entire period—a Sharpe ratio of 0.55 vs. 0.36. The trades generated by our first indicator (shorts initiated relative to longs) had an even higher average return per unit of risk—a Sharpe ratio of 0.82 vs. 0.35 for passively holding a contract long over the entire period. While our third indicator, which anticipates when positions will become caught "offside," had a higher average Sharpe ratio than passively holding a futures contract long over the period, our second indicator, which identifies current P/L that is caught "offside," did not produce an average Sharpe ratio above that of passively holding the futures long.

We also found that our signals were most persistent for our first indicator (shorts initiated relative to longs) and least persistent for our third indicator (shorts' P/L "offside" if 2 standard deviation price move). The median number of consecutive days that a trade was "on" across contracts (that a signal was beyond 2 z-scores) was four days for our first indicator, two days for our second indicator, and one day for our third indicator.

Across asset classes and regions, there were notable differences in the performance of the three different indicators. On average across asset classes, the indicators added the least value (beyond passively holding the underlying futures long) in bond futures. This may, to some extent, reflect the use of these bond futures in curve trades and spread trades not currently identified in our model. However, on average across US 2-Year, 5-Year, and 10-Year Treasury Note futures, the trades generated by our third indicator had a Sharpe ratio more than 1.5 greater than passively holding these contracts long over the entire period.

Across the major developed market equity index futures, the results were consistent with our average findings across asset classes (the trades generated by our third indicator had a higher return per unit of risk than passively holding the futures long over the entire period; the first indicator generated an

Exhibit 5

	INDICATOR 1	INDICATOR 2	INDICATOR 3
	Shorts Initiated Relative to Longs (% of Open Interest)	Shorts' "Offside" P/L Relative to Longs (% of Open Interest)	Shorts' "Offside" P/L Relative to Longs if 2 Standard Deviation Price Move (% of Open Interest)
Average Strategy Sharpe Ratio	0.82	0.23	0.55
Average Futures Passive Sharpe Ratio	0.35	0.37	0.36
Average Improvement of Strategy to Passive Futures Sharpe Ratio	**0.47**	**(0.14)**	**0.18**

2 On average, our first indicator generated a signal beyond 2 z-scores in a given contract on 3% of days; our second indicator generated a signal beyond 2 z-scores on 4% of days; our third indicator generated a signal beyond 2 z-scores on 2% of days.

even higher return per unit of risk; the second indicator did not generate returns per unit of risk above those of passively holding the underlying futures long). However, across the major emerging market futures, and the Asian equity futures in general, the second indicator (shorts' P/L currently "offside") returned the highest average Sharpe ratio. This indicator most closely resembles a trend following strategy (anticipating that positioning changes will further extend a given price movement), while our first indicator (shorts initiated relative to longs) is closest to a mean reversion strategy (anticipating that investors are more likely to reduce extreme buildups of positions in one direction, rather than further add to them). Across the agricultural futures (though not across the metal and energy futures), the second indicator (shorts' P/L currently "offside") also returned the highest average Sharpe ratio of the three indicators.

PORTFOLIO RESULTS

We constructed portfolios applying our three indicators to all 53 futures markets on an equal risk-weighted basis (based on the historical volatility of each market's daily returns). Our indicators generated trades in at least one of the contracts in our basket of 53 contracts between 58% of days (third indicator) and 67% of days (second indicator). While our first and third indicators, in particular, added value on average across markets, the question arises as to how correlated each of these indicators might be, and which indicator offers the best return to risk profile at the portfolio level. Since we implement our strategies only when a signal is beyond 2 z-scores, measuring the correlation of an indicator across contracts is challenging, as we're primarily concerned with how often a given indicator is at extremes across contracts. One way to estimate this is to find the average percent of time that an indicator is simultaneously "on" across pairs of markets. We found that, on average, our first indicator (shorts initiated relative to longs) was simultaneously "on" across pairs of contracts 6% of the time that it was "on." Our third indicator (shorts' P/L "offside" if 2 standard deviation price move) was considerably less correlated across contracts — on average, simultaneously "on" across pairs of contracts 3% of the time that it was "on." Our second indicator (shorts' P/L currently "offside") was the most correlated across contracts — on average, simultaneously "on" across pairs of contracts 8% of the time that it was "on."

The differing correlations across indicators were also evident in the relative performances of the indicators at the portfolio level. As outlined above, our second indicator (shorts' P/L currently "offside") had the lowest average Sharpe ratio of our three indicators across contracts. Our second indicator was also the most highly correlated indicator across contracts. At the portfolio level, our second indicator had a considerably lower return to risk ratio than our first or third indicators.

While the trades generated by our first indicator had the highest average return to risk ratio across contracts, a portfolio applying our third indicator to all 53 futures markets on an equal risk-weighted basis had the highest return to risk ratio of our three indicators (slightly higher than that of our first indicator). The results suggest that, at the portfolio level, a strategy informed by positioning in relation to price (an anticipatory "pain trade" strategy) adds value beyond a strategy informed by positioning alone.

We plan to run these three trading indicators daily across a broad basket of futures, and highlight when our indicators generate signals beyond 2 z-scores. While the above data describe the average results of our trading indicators across a wide range of futures contracts, there was considerable variation in the performance of each indicator in different markets and in different environments. We can provide more details on the backtest results of each indicator for specific contracts.

Our backtest results suggest that our "Pain Trade" indicators can add value to a systematic trading strategy. We also believe that our "Pain Trade" indicators can be useful tools for informing discretionary trades. In our futures content offering, we think that overlaying our "Pain Trade" metrics with other futures indicators and observations can identify the most compelling instances of asymmetric risks across markets.

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