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# PACKED IN LIKE SARDINES

## How crowding in trade flow can adversely affect execution costs


### Executive summary

**Alternative Risk Premium strategies have received investor attention over the past few years and consequentially assets allocated to these strategies have increased. This, in turn, has given rise to a fear of concentration, most commonly referred to as crowding. Moreover, a spell of modest returns – especially in 2018 – has led investors to question the efficacy of these strategies, with the blame for sub-par performance often ascribed to crowding. Investors are not only concerned that a crowded market or strategy results in deteriorating returns as participants chase the same opportunities, but that sell-off risk, when large positions in the same assets are liquidated at the same time, also increases. In this note, we instead discuss a simple, yet real example of how crowding in trade flow may result in deteriorating returns by increasing the cost of execution. We show how, with a dedicated and bespoke execution solution, we can reduce some of the risk that arises from participating in a crowded trade.**



### Contact details

Call us +33 1 49 49 59 49
Email us cfm@cfm.fr

# Introduction

The topic of crowding has garnered much attention of late, with many investors fretting about the consequences for Alternative Risk Premium (ARP) strategies. Any strategy could be called 'crowded' if too much capital is deployed in said strategy given its usual reward and market liquidity [1]. This crowding is generally thought of as being in the positions of an asset, while less literature exists on the subject of crowding in typical trade flow.

If a strategy is taking advantage of mispricing it may be that the existence of many players chasing the same opportunity reduces the magnitude of such an opportunity.[1] Academic literature often discusses how the market is exposed to systemic risk when similar portfolios are held by a large number of investors. This concentration, or crowdedness, may have a material impact in the event that investors simultaneously head towards the exit. Liquidation by a large actor, or the concurrent liquidation by a set of smaller investors, can depress valuations, with resulting losses causing further liquidations and eventually cascading losses among all participants [1, 2, 3]. Such tail risk events are significant but rare. In traditional markets they commonly go under the name of 'bubbles' while examples such as the Quant Crunch of August 2007 [1] reveal the existence of exactly equivalent effects in a market neutral setting.

We address in this paper a less discussed aspect of crowding, due to correlated trade flow that is detrimental to a strategy's performance even under normal, everyday conditions. The work is discussed in detail in [4] and is the subject of this short note.

# Transaction costs and price impact

Once a trading strategy has been identified in a paper traded backtest, an execution strategy needs to accompany its passage through to being used in an investment program. The resulting execution can be done in various ways, ranging from traditional voice broking, simply calling and placing an order with a broker over the phone, to developing algorithms that will automatically, and systematically analyse the most optimal execution strategy. All solutions have one thing in common: the final trades almost never occur at the exact same price as what prevailed at the time when the order was placed. This discrepancy is called 'slippage' and it has several origins.

Trading is not free, it commonly involves brokerage and exchange fees borne by the investor, as well as a component related to the bid-ask spread. Beyond that, for institutional investors, the largest contribution often comes from 'price impact' whereby repeatedly buying the same asset in order to build up the desired long position will drive its price up, or selling it will drive its price down.

We discussed in a prior note [5], that when trading Q shares in total, trading cost per share is well approximated by the square root formula:

$$C \approx constant \times \sqrt{\frac{Q}{V}}.$$

Here V denotes the total market volume traded on the day, the ratio of Q and V is thus one's own rate of market participation. What the formula as such represents, is the slippage per share. Therefore, in order to calculate the total execution cost for the trade one needs to multiply the result by the number of shares executed Q.

# Price impact and the capacity of a trading strategy

Let us take a concrete example. Imagine a trade idea on Company X shares that is expected to generate 8 cents of profit. The liquidity of this stock is around 15M shares exchanged per day, so trading 1% of the market allows one to open a position of 150,000. If this trade could be entered into for free, one would expect a profit of $0.08 × 150,000 = $12,000. Using actual figures, the above square root formula predicts an execution cost of $3,900 on the same trade, leaving us with a more realistic final gain of $8,100, which is still reasonable. Note that one would still have to exit the position to recover such gains, again incurring cost. For the sake of simplicity, we are going to neglect this cost for the purpose of this paper.

In order to establish, in our example, a position of 150,000 shares, several individual trades will be required to fully execute the order. Figure 1 illustrates that these consecutive trades, on average, would happen at gradually higher prices ever closer to the price target, due to price impact and following the square root rule.

[1] Especially true for convergent strategies. Such a mechanism for divergent (trend) strategies is less clear!

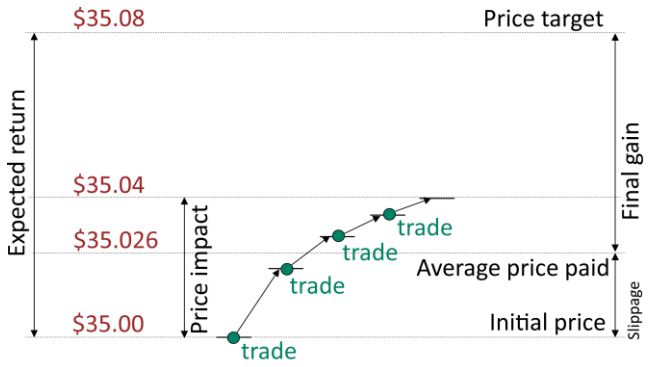


**Figure 1:** The expected trajectory of market price in an example of buying 150,000 shares of Company X. As the consecutive trades are executed, the price increases gradually due to price impact.

The total expected gain of the position grows proportionally to the size: if instead of 150,000 we trade 600,000 shares, gains are expected to increase fourfold. However, costs do not increase linearly, but grow more quickly: every time we enlarge a position it costs progressively more to execute. Consequently, 600,000 shares will incur eight times more execution cost than trading 150,000 shares would. This effect on the final gain is illustrated in Figure 2.

Profits very quickly fall short of naïve expectations. Increasing trade size above a certain limit no longer results in increased profits, and even becomes counterproductive once the price is pushed beyond our own price target.

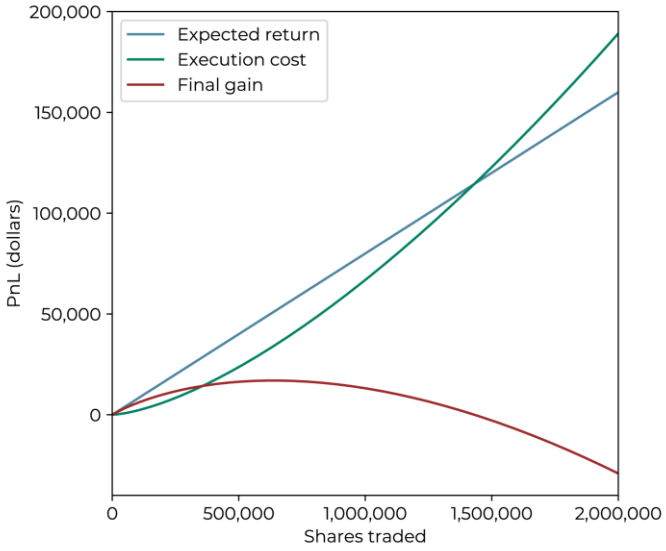


**Figure 2:** A profitability analysis of the example trade shows that expected returns grow proportionally to the number of shares traded (blue curve), but, execution cost (green curve) increases at a faster rate. The final gain (the difference of the two, and illustrated by the red curve) reaches a maximum at a given level of trading and then decreases with order size.

A sure-fire way to increase expected gains is by limiting the total cost of execution despite the placement of a larger order. This is done by deploying better, bespoke execution algorithms. Eventually, however, costs always catch up and overtake expected gains. This effect of diminishing returns with ever larger orders is what limits the 'capacity' of investment vehicles, and it is the principal reason why successful funds are often closed to further investment. They have then reached a size beyond which there is little room left to invest gainfully and adding more assets, or increasing leverage becomes detrimental to performance.

# Impact and capacity with crowded flows

A recent empirical paper [6] has shown that the price impact of buying/selling a given amount in a stock is the same regardless of whether the trade is executed by a single large investor, or by an accumulation of multiple smaller investors acting simultaneously. The authors coined the term 'co-impact' to describe this collective effect of supply and demand. As a consequence of this, the capacity of any trading strategy is shared among all market participants, thus giving rise to the concept of 'crowded' trades that potentially increase a given strategy's execution cost and reduce its potential to generate gain.

Let us return to the example of the Company X trade in the previous section. This trading strategy returned 8 cents per share if it could trade for free. Figure 3 shows the final gain curves corresponding to different scenarios measured using the academic trade database as described in [6]:

- The blue curve illustrates the theoretical gain given the average quality of execution combined with the *typical* level of crowding experienced by institutional investors. In this scenario, gains of up to $5,400 could be extracted
- If the trade is executed on a day *typically less* crowded than average, the maximum gain increases to $16,000
- On days *typically more* crowded than average the maximum gain dwindles to just $640

We will return to the interpretation of the two remaining dashed curves shortly.

These differences are large and explained by the extra contribution to cost arising from executing with or against the net flow of trades of all investors pursuing a given strategy. It is no longer just the trades of one investor that count towards the cost of trading but also how similar that trading is to all other trades in the market.

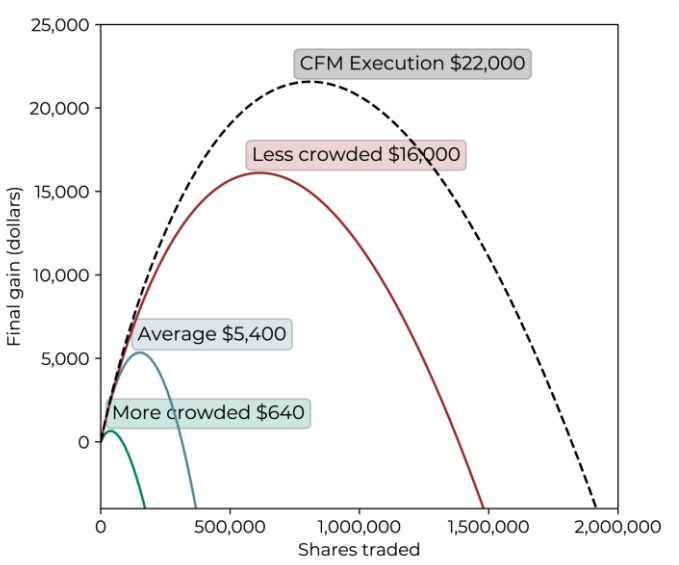


**Figure 3:** The final gain of the example trade of Company X under the same 8 cents of expected return assumption, but with different scenarios for execution costs. In each case, gains first grow as the sizing of the trade increases, before saturating at different maximum levels and subsequently decreasing due to the increasing, and dominant contribution from execution cost. One expects lower gains in the case of a crowded strategy, as the variation of the solid curves obtained from measured costs in the academic database as described in [6]. Also overlaid is a curve corresponding to CFM's execution of both its Alpha and Alternative Beta programs. Both of these have sizeable assets under management, and their measured costs for similarly sized orders are statistically indistinguishable. As described in the text, an understanding of execution research and a knowledge of crowding are essential to increasing the overall net gain.

# The capacity of Alternative Risk Premium strategies

A recent study [7] analysed the capacity of investing in the 'Fama-French' factors in the US equity market including both commissions and trading costs. It was found that the Size, Value and Momentum factors can manage around $30B, $1.5B and less than $100M, respectively. These numbers are defined as the level of assets above which the costs exceed expected returns. They are low and definitely below the actual assets managed in such factor strategies. In fact, it is estimated that global ARP assets under management have reached $150 - $200 billion [8]. The construction of the Fama-French factors and the subsequent portfolio construction is somewhat academic in nature and certainly not built for running a scalable ARP program.

There are, however, ARP funds that have delivered tangible gains over the past decade. Not all ARP strategies are affected equally by crowding. Let us yet again return to our example of the Company X trade, but this time using CFM's own trades, measured using the same method as in [6], and applying the usual 8 cents of expected gain. We find a maximum gain of $22,000, illustrated by the dashed black line 'CFM Execution' in Figure 3. The measured cost of trades generated by CFM's ARP offering is statistically consistent with that of its (a priori less crowded) Alpha strategies.

The fact that the results are similar indicates that CFM's ARP products, in terms of crowding, are indistinguishable from those of CFM's more bespoke hedge-fund type Alpha strategies. The crowded trade flow may exist but is not large enough to be measured with the current level of statistics. As we accumulate more data, maybe these differences will be detected, but, for the moment at least, we can conclude that such effects are small.

# How does CFM deal with crowding?

### Non-standard implementation

Strategies in the ARP space are well documented in the academic literature, and it is advisable to avoid the most widely known implementations, for example the ones proposed by Fama and French. By taking a different, non-standard strategy and portfolio construction approach, CFM can both improve performance and alleviate crowding effects. A non-standard implementation of robust, and persistent ARP, will exhibit greater expected returns since trading will not consume liquidity concurrently with others at times of rebalancing.

### Lower turnover

The best way to reduce execution costs is to not trade at all! One can make large savings by reducing the turnover of the strategies. This is typically achieved by designing strategies that rely on slower models, combining multiple signals, and trading in a controlled manner when they are aligned.

### Targeted liquidity

When a portfolio requires rebalancing, it is prudent to concentrate the largest trades on the most liquid

products, and to avoid excessively pushing the price of illiquid ones, where co-impact/crowding effects may be largest.

**Bespoke execution algorithm**

Finally, execution costs and the ability to navigate a market with many participants does depend on one's trading style. We have developed a proprietary execution platform over the past 15-20 years with our in-house algorithms and market connectivity tailored precisely to the needs of each strategy. By crafting a bespoke execution algorithm, we can both better time, and size orders for each strategy.

# Take-home message

Execution costs have a very significant impact on the profitability of trading strategies. Crowded trade flow increases such costs, and substantially diminishes the net gains of a portfolio. While crowding concerns in ARP strategies warrant an assessment, our own research reveals that we cannot confirm the presence of crowding, nor does it seem to affect the performance or execution capabilities of CFM's ARP offering.

CFM remains committed in our pursuit of applied research on this topic, and continues in its invaluable collaboration with academic researchers on the subject of co-impact. Upcoming papers will include further direct measures on ARP crowding in order books and trade flow. We hope to share detailed results on these topics in the near future.

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# Disclaimer

# CFM has pioneered and applied an academic and scientific approach to financial markets, creating award winning strategies and a market leading investment management firm.

## Contact us

**Capital Fund Management S.A.**
23, rue de l'Université, 75007
Paris, France
T +33 1 49 49 59 49
E cfm@cfm.fr

**CFM International Inc.**
The Chrysler Building, 405 Lexington Avenue - 55th Fl.,
New York, NY, 10174, U.S.A
T +1 646 957 8018
E cfm@cfm.fr

**Capital Fund Management LLP – Sydney branch**
Level 16, 333 George Street
Sydney, NSW, 2000, Australia
T +61 2 9159 3100
E cfm@cfm.fr

**CFM Asia KK**
9F Marunouchi Building, 2-4-1, Marunouchi, Chiyoda-Ku,
100-6309 Tokyo, Japan
T +81 3 5219 6180
E cfm@cfm.fr

**Capital Fund Management LLP**
64 St James's Street, London
SW1A 1NF, UK
T +44 207 659 9750
E cfm@cfm.fr