

**Mind the Gap –
Construction and Backtesting of a Trend Following Gap Trading System**

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1 Introduction

About 40 years ago, Eugene Fama published his highly influential article “Efficient Capital Markets”, in which he distinguishes three types of efficiency present in financial markets. The notion that stock price movements follow a *random walk* and are therefore not predictable still plays a major role in most finance models, e.g. the Black and Scholes Option Pricing model. Another key component in the theory of efficient markets regards the incorporation of new information.

In its weakest form, the Efficient Market Hypothesis postulates a constant flow of information, so that the prices always reflect all information available. Discontinuities or jumps in a stock’s chart at the opening bell thus have been of interest for technically oriented short term investors, who use statistical indicators, chart patterns and heuristics to trade the markets. What at first looks like a disproof of the markets’ efficiency unravels itself as the exact opposite, i.e. the symptom of new information being processed after a period of discontinued trading.

When Fama wrote his article, engaging in transactions on the financial markets just became easier to handle thanks to a beginning computerization of business. This lead to higher trading volume and a reduction in transaction costs for brokerage firms (Wells, 2000). Nevertheless, directly accessing the markets was still nearly impossible for individual investors. In modern finance, the costs of setting up the necessary equipment to get access to the markets is negligible, even the costs for receiving real time tick data are not substantially high. Additionally, computer programs are able to automatically execute trades based on a defined plan. In order to keep up with the rising pace in financial markets, building a consistently profitable and easy to implement system becomes more and more important.

With regard to gaps, most investors, trying to benefit from this recurrent phenomenon, focus on systems that assume gaps to be short term deviations from the efficient market ideal. They think that some irrational investors process new information differently than the rest, which forces prices to break out of their trading range. Following this line of thought, rational investors would then regard this as an overreaction and trade against it, prompting the gap to close again.

On the other side, relatively few professional traders and studies present evidence for a strategy that goes against conventional wisdom and follows the trend pointed out by opening gap. The aim of this thesis is to evaluate the feasibility of such a strategy based on a comprehensive trading model.

We argue that volume on the day of the gap can be used as an indicator that separates money-making occasions from those on the losing end. Furthermore, overall profitability of a portfolio depends profoundly on the right selection of instruments, or in our case stocks. Having identified volume as overly important, we simulate the daily change using a MA(3) – process. Regarding the dramatic drop in profits with this approach, we speculate that volume follows a different, perhaps non-linear, stochastic process that could not be captured with our model.

The rest of the thesis is organised as follows. Chapter 3 presents basic metrics used to measure gaps, profit and risk as well as filter rules for stock selection. After a first simple test of gap trading on the chosen stocks, the following chapter examines options to tweak the system to be profitable. A final part concluding the insights from chapter 4 is followed by a general conclusion on the thesis. A discussion of the system's limitations and weaknesses leads to recommendations for further revisions on the subject. The subsequent chapter 2 introduces gap trading and distinguishes important types of gaps, which will be necessary to keep in mind for the remainder of the thesis.

5 Conclusion

5.1 Summary

The aim of this thesis was to assess whether a trading system following the direction of an opening gap - as opposed to the traditional procedure to trade against it - could yield attractive results. In pursuit of this goal, we first and foremost defined various categories of opening gaps and presented hypotheses of why gaps occur in general. We concluded that in particular firm-specific events like earnings announcements could trigger gaps overnight and that breakaway as well as continuation gaps could show the greatest potential for our strategy.

Based on our findings we then chose several stocks which we thought of were predetermined to experience a large number of gaps due to their vivid response to market-wide as well as idiosyncratic incidents. Moreover, volume and market interest proxied by market capitalisation were also part of our filter, which led us to include companies from the sectors financial, basic materials, semiconductor and consumer good production.

After a short inspection of the gap distributions, we presented the tools used to measure profitability and risk, namely profit factor, the Sharpe Ratio and a simple Value at Risk concept. The conclusion of chapter 3 included a first test of the simplest gap trade system imaginable, which would follow in the direction of every gap. The test showed profitability for single stocks and the S&P500, which was included as a benchmark, but the system as a whole in need of improvement.

Chapter 4 addressed the issue of optimisation based on, among others, the inclusion of a varying gap size. If a trader decides to apply a fixed gap size for a variety of stocks the variation in profit factors between a 0.5 and 1 per cent gap is negligible as long as no other aspects are taken into consideration.

One of these aspects is a stop loss which automatically clears a position once a certain price barrier is breached to prevent further losses. We experimented with several stop losses and concluded that the optimal level for a stop loss depends on other specifications such as the gap size. In general, stops set around the closing price outperform

stops at a fixed percentage of the opening price with regards to profitability. But at the same time, there is more risk involved, so the most advantageous setup again depends on how the trader solves his personal risk-return trade off problem.

The most interesting chapter 4.4 addressed volume as a tool to distinguish continuation and breakaway gaps from less promising common and exhaustion gaps. We compared the volume as shares traded on the day of the gap to simple moving averages of various lengths. It emerged that the activity in a stock indeed gives an indication for the type of gap that occurred. For up gaps occurring on above average volume, the results suggested that they represent continuation or breakaway gaps and experience higher returns in the long run. For down gaps the opposite holds true, i.e. below average volume signals a continuation of the downward trend. In perfect hindsight, adding a percentage stop around the opening price showed the most promising results in the short run.

Trying to forecast daily volume with a MA(3) – process of the previous three lagged shocks, we quickly reached the limits of this stochastic method. Compared with real volume, profit factors in this part declined sharply, regardless of the volume average used. Over longer trading periods and for a given set of random variables, the results however roughly confirmed our observation made in chapter 4.4 regarding the categorization of gaps depending on above and below average volume, though less consistently.

Consequently, we tried to gain more accuracy by looking at the price action on the day before the gap and concluded that positive days followed by up gaps coincide with returns for the 10 day horizon that outperform those for gaps that occurred after a red candle. The relationship seems to be stronger for down gaps, which show significantly higher yields if the previous day closed lower than it opened.

Finally, in the previous part we brought together our insights gained in the preceding chapters to comment on the most effective way to trade the opening gap and already addressed limitations to the approach.

5.2 Limitations and Outlook

During the work on this thesis, several limitations concerning methodology and gap trading in general came up. One of the biggest limitations are transaction costs that we did not include in the greater part of the analysis. Brokerage fees and slippage costs occur every time a trade is executed and take a bite out of every profit made. The neces-

sary position size to make up for transaction costs vary with the setup but should have exceeded the average trader's bankroll over the observed years.

Addressing the research question whether it is possible to construct a profitable trend-following gap trading system, the answer depends on multiple aspects for the following reasons.

We have seen that particular compositions of gap size, stop loss and others can create reasonable profits while still maintaining an acceptable level of risk. Each new indicator that is added or subtracted from the system changes the outcome dramatically due to the interrelations between the different parts. Thus the optimal structure is affected by the trader's appetite for risk and his personal characteristics. Stop losses for example tend to reduce net profit as well risk and help the trader to distance himself psychologically from his trades.

In each sub-chapter, we added complexity to the system often to realize at the end that the results sometimes changed completely, making previously profitable stocks money losing ones and vice versa. The inconsistent developments could really originate from the underlying fundamentals or could be part of a statistical bias from including only four stocks in our sample. In hindsight, choosing the right stocks or financial instruments in general is crucial for the system's feasibility. Revising on the subject, we would use a slightly larger sample to be able to make more informative statements concerning average values.

Nevertheless, we showed that, under certain specifications, gap trading could be profitable, at least based on the time we analysed, for stocks featuring the right characteristics. The next step in this respect would be to implement such a strategy in a trading platform with live market data and evaluate its performance in everyday trading. However, looking for a 'quick buck' in trend-following gap trading, accurately estimating volume as the best predictor for success requires more sophisticated models probably not available to the ordinary investor.

That being said, for the moment we conclude that following the trend indicated by the opening gap is only feasible for investors with the technological means to estimate stochastic models for forecasting daily volume for a large array of stocks and other instruments. Furthermore, the investor would have to minimise transaction costs or hold sufficient funds to cover them by taking on appropriate positions. All in all, for now this

would only leave institutional investors as potential candidates to successfully implement profitable trend following gap trading algorithms.