EAM INVESTORS

Momentum and Trading Costs

Empirical evidence has shown momentum as a persistent and robust source of excess returns in global equity markets (Momentum Works Everywhere). However, momentum investing requires frequent trading to effectively harvest the premium (The Quick and the Dead). The associated trading costs, including commissions and price disparities between buying and selling, can erode profits from momentum investing potentially undermining its alpha proposition. Consequently, a considerable gap may exist between theoretical returns suggested by academic research and actual results achieved in real-world implementation. This paper explores the relationship between momentum investing and trading costs by examining the sources and measurement of these costs, reviewing pertinent academic literature, discussing practical implementation solutions, and providing our own evidence supporting the survival of the momentum premium despite trading costs.

Travis Prentice
Chief Investment Officer
Portfolio Manager

David Wroblewski
Director of Applied Research

Trading Cost Primer: Implicit and Explicit Costs

Trading costs refer to the expense investors incur when buying or selling stocks. These costs are generally divided into two main types: explicit and implicit. Explicit costs are typically easier to measure and include such things as broker commissions and exchange fees. Financial intermediaries such as an executing broker receive commissions for facilitating transactions in listed equities. Managers typically negotiate commission rates, leveraging their size, relationships, and trading volume to potentially lower costs. However, when selecting a broker, considerations beyond commission rates are crucial, including execution quality, operational prowess, and counterparty risk. Additional explicit costs include exchange fees, taxes (more on this in future research), data/regulatory fees, and charges from clearing counterparties to ensure proper settlement.

Implicit costs, on the other hand, are indirect costs that are not directly observable, but rather embedded within the final price of a trade. These costs encompass bid/ask spreads, market impact, and slippage. The bid/ask spread represents the difference between the price sellers are asking and the price buyers are willing to pay. Wider spreads increase trading costs, particularly for less liquid stocks or in volatile markets. Market impact refers to the effect that a trader's buying or selling activity has on the price of an asset, typically moving against the trader's interests. For instance, large purchases may push the price higher as orders fill at progressively elevated prices, while large sales may drive the price down. Slippage, or the difference between expected and actual trade prices, can further add to costs, particularly in fast-moving markets. While implicit costs are generally more challenging to define and measure, they can constitute a significant portion of the total cost of a trade[1].

Momentum and Implicit Trading Costs

Explicit trading costs are more easily measurable and should be included in any manager's reporting to clients. Implicit costs, however, are much more challenging to define and measure. Generally, the measurement of these costs comes down to the difference between the transacted price and a benchmark price. The most common benchmarks used today are pre-trade price and/or a volume-weighted average price (VWAP).

Pre-trade price analysis compares either a decision price (when the manager made the decision to trade), an arrival price (when the trader receives an order), or a start price (when the trader began execution) to the actual executed price. Pre-trade benchmarks are not influenced by execution quality, as they only include pre-execution prices. Thus, pre-trade analysis nicely captures all implicit costs (bid/ask spreads and market impact) but also incorporates changes in the market unrelated to the quality of the execution.

A VWAP analysis compares the execution price against the volume-weighted average price over a specified period[1]. The most common measurement includes the VWAP during the time the trader was executing the order compared to the actual executed price. Alternatively, the VWAP measurement period can be varied to the full-day or a pre-determined specific time interval (1-day or 2-day forward, etc.). The upside of a VWAP analysis is that it incorporates both price movements and volume data, providing a more accurate reflection of the quality of execution. The downside of VWAP analysis is that the measurement includes the manager's own trades, making it potentially manipulated by the traders themselves[2].

[1] A VWAP price is calculated by dividing the cumulative sum of prices multiplied by volume at each price by the cumulative volume over a specified period. [2] For reference and further reading: *Hedayati, Saied; Hurst, Brian K.; Stamelos, Erik, "Transactions Costs: Practical Application", AQR (2019)*

There is no consensus or industry standard as to the selection of the benchmark in measuring the implicit costs of trading. Each measurement is potentially noisy and can be highly variable through time. Additionally, an execution strategy and the selection of a benchmark should reflect the manager's alpha proposition. For example, a manager exploiting the value premium where patience is often a virtue might have a different trading strategy than a momentum manager whose time is of the essence. Consequently, cross comparisons between opposing managers based on pre-defined measurements of trading costs can be problematic.

Literature Review: Academics Cast Doubt

One of the earliest and most influential academic studies examining how trading costs affect the performance of momentum strategies was conducted by Keim and Madhavan (1997) in their paper titled, "Trading Costs and Returns for Momentum Strategies". Their key findings were as follows: 1) momentum strategies incur high transaction costs due to frequent rebalancing and the tendency to trade in small and illiquid stocks; 2) total transaction costs are proportional to turnover and are significantly higher for small cap portfolios compared to large cap portfolios; and 3) for small cap momentum strategies, trading costs often offset gross profits, while for large-cap stocks, some net profits remain after costs. Their study focused on stock data from 1963 to 1993 and included both estimated implicit and explicit costs (bid-ask spreads, institutional commissions, modeled price impacts). Further, they found that momentum strategies require frequent portfolio rebalancing, resulting in turnover of 150% to 200% annually. For context, they found that total trading costs for small cap stocks were approximately 7 to 9% per trade and 1 to 2% for large cap trades. Thus, incorporating turnover, they found total costs to be 2 to 4% for large cap portfolios and 10 to 18% for small cap portfolios. Overall, they concluded that illiquidity and trade size largely influence price impact, while turnover is a key driver of total trading costs.

Similarly, Lesmond, Schill, and Zhou (2003) in their paper titled "The Illusory Nature of Momentum Profits" found that: 1) momentum strategies appear highly profitable on a gross return basis, but once trading costs are accounted for, particularly for small and illiquid stocks, the profits largely disappear; 2) a significant portion of observed momentum profits come from small and illiquid stocks, and these stocks have higher trading costs due to larger bid-ask spreads and substantial impact from trading; 3) momentum strategies in large cap stocks may remain profitable; and 4) turnover amplifies these costs. The key innovation of this study was its attempt to estimate trading costs by using the zero-return measure. This approach estimates implicit trading costs by assuming that if trading costs were zero, a stock's return over a given period would exactly match the market return. However, if a stock's return deviates from the market return (and not explained by fundamentals), that deviation is attributed to trading costs. They found estimated trading costs were 5% to 10% per trade and 1 to 2% per trade for small and large cap, respectively. Turnover was estimated to be between 200% and 400% for small cap and 200% to 300% for large cap. The study used data from the years 1963 to 1999.

Additionally, Korajczyk and Sadka (2004) in a paper titled, "Are Momentum Profits Robust to Trading Costs?", found that: 1) real-world applicability of momentum strategies is challenged, especially for institutional investors who must account for transaction costs; 2) momentum strategies focusing on large-cap stocks with lower liquidity risk are more likely to remain profitable in practice; and 3) magnitude of momentum profits vary based on the liquidity of stocks involved, where wider bid-ask spreads and price impact of illiquid stocks erode profits totally. They estimated the price impact of trades by using stock data from 1963 to 1999 and computing a price impact function to estimate how stock prices are affected by the size of trades. Their sample included actual trade data with detailed information on trade size and price, which they used to form a regression model estimating the relationship between trade size and price impact in momentum portfolios. Their analysis found trading costs similar to those reported by Lesmond, Schill, and Zhou (2003).

Overall, these historical academic studies have served to cast tremendous doubt and helped to form static opinions on momentum's viability as an investment strategy in practice due to high trading costs. Moreover, they are almost unanimous in condemning small cap momentum strategies due to the perceived illiquidity and higher market impact costs of smaller stocks. However, these influential academic studies relied on sample market data last collected in 1999 before decimalization in US equity markets (April 2001) and relied mostly on estimated trading costs to draw their conclusions. Nevertheless, they were all astute in the observation that trading costs, liquidity, and turnover are non-trivial challenges to momentum strategies in practice.

Literature Review: Practitioners to the Rescue?

Interestingly, more recent studies on the viability of momentum-based strategies in practice have been written by practitioners. In their paper "*Implementing Momentum: What Have We Learned?*", AQR (2017) finds that real-world trading costs for momentum strategies are 5 to 10 times lower than estimates from academic studies. Academic models, often based on outdated datasets like the TAQ database, assume trading costs for large cap equities between 1% and 2% per trade, driven by large price impacts, high turnover, and simplistic trading assumptions. In contrast, AQR's real-world data shows trading costs of 0.15% to 0.35% per trade for large cap stocks and 0.5% to 1% per trade for small cap stocks, due to better execution methods like algorithmic trading and market-aware strategies. This lower cost structure allows for an estimated long-short momentum strategy capacity of $56 billion, over 10 times higher than prior academic projections. These findings highlight the critical difference between theoretical and practical trading environments.

Furthermore, BlackRock (2017) in a study titled, "Factor Investing: From Theory to Practice", concludes that momentum strategies remain viable in practice but need to be carefully managed, particularly with respect to turnover and trading costs. Specifically, using their own trading data and modern execution models, they found large cap trading costs to be generally around 0.3% to 0.5% per trade and small cap at 0.5% to 1% per trade. However, by using tools like smart order routing and algorithmic trading, investors can reduce execution costs by up to 50%, making momentum strategies more scalable and profitable than many academic models had predicted.

We acknowledge that practitioners who are selling investment products have a vested interest in their conclusions. However, academics generally have vested interests as well albeit perhaps less obvious (efficient markets hypothesis anyone?). Still, the fact remains that there is a large gap between academics and practitioners on this subject. This gap may exist to the following factors: 1) academic models often rely on historical data that doesn't reflect modern trading infrastructure; 2) academics assume constant trading costs and ignore execution optimizations like algorithmic trading and smart order routing; and 3) academics do not account for portfolio scaling and/or global diversification efforts that can significantly reduce trading costs.

Implementation Solutions at EAM

At EAM, we benefit from our founders' extensive experience of nearly 30 years (27 to be exact) in implementing momentum investment strategies. This wealth of practical knowledge combined with our ongoing research on the subject has enabled us to design an implementation solution that seeks to minimize trading costs and preserve the momentum premium for our clients.

Firstly, our approach begins with a focus on liquidity. We limit the capacity (AUM) of our investment strategies to preserve the stock-by-stock liquidity necessary to transact within the selection universe for each strategy and the underlying portfolio constituents. In this regard, we also broadly diversify the portfolio to reduce concentration risk and further improve liquidity/costs.

Secondly, we consistently focus on reducing trading costs by seeking lower commissions and minimizing implicit costs, including the market impact of our transactions. This is achieved through our experienced trading team which is incentivized to focus on reducing implementation costs associated with momentum trading. The trading team utilizes multiple trading venues to optimize routing and algorithmic trading to minimize market impact. Each order is managed uniquely, taking into account the specific equity, the prevailing market environment, while applying their experience with low-latency execution. Moreover, we regularly measure the effectiveness of our trading using a third-party transaction cost analysis vendor. This analysis provides both VWAP and implementation shortfall measurement which we use to identify any potential issues and to seek continuous improvement in our trading process.

Thirdly, we seek to optimize turnover based on our Informed Momentum® investment approach. Through more holistic momentum measures, the addition of business rationale to explain the momentum signals, and a tailored risk management approach, we believe we can more effectively balance the risk/reward of our transactions. We adjust rebalancing frequency based on market conditions and when signals present themselves on a stock-by-stock basis as opposed to on a calendar-based schedule. Furthermore, we incrementally adjust weightings to adapt to momentum changes rather than fully rebalancing the entire portfolio on a specific date.

Lastly, we seek to be a leader in offering low fee management services to minimize the erosion of alpha. High management fees can significantly diminish the alpha proposition of a momentum strategy. We believe low fees further align our interests with clients over the long term.

In summary, EAM's momentum investment approach leverages nearly three decades of expertise to deliver an efficient, client-focused strategy. Our Informed Momentum® approach centered on liquidity management, cost efficiency, and turnover optimization, seeks to effectively capture and preserve the momentum premium. This comprehensive framework, built on experience and ongoing research, enables us to navigate market dynamics effectively while aligning our interests with those of our clients for long-term success.

A Focus on Trading Costs

We measure the effectiveness of our trading through implementation shortfall and placement-to-execution VWAP (Volume-Weighted Average Price) analysis.

VWAP analysis is particularly useful in assessing execution quality. This measurement compares the actual executed price to the volume-weighted average price of all executions on major exchanges calculated during the period from order placement to final execution. The analysis further ranks our performance against peers who are transacting in the same security during the same period, evaluating both relative market impact and commissions.

The below VWAP analysis measures the quality of EAM's trading using representative accounts within the US Small Cap and Non-US Small Cap strategies for the 2023 calendar year. The results demonstrate favorable net market impact results and peer rankings for both strategies. The US Small Cap strategy beat peers by 6.4 basis points on market impact, ranking EAM in the top quintile (13%). Our Non-US Small Cap strategy beat peers by 14.8 basis points, placing EAM in the top decile (4%).

Additionally, commissions for each strategy are measured and compared to the Global Trade Analytics peer universe (GTA clients plus transactions custodied at State Street). Results show that EAM's commissions were 1.9 basis points better than peers for both strategies. Taken together, these measures show a total benefit of 8.3 basis points relative to peers for the US Small Cap strategy and 16.7 basis points relative to peers for the Non-US Small Cap strategy.

Placement-to-Execution VWAP Analysis

EAM US Small Cap	Trailing 4 Quarters
Market Impact (bp)	6.4
Peer Universe Market Impact (bp)	0.02
Net Market Impact (bp)	**6.4**
EAM Peer Rank	13%
Commission (bp)	(6.1)
Commission Universe (bp)	**(8.0)**
Net Commission Benefit (bp)	**1.9**
Total EAM Benefit (bp)	**8.3**

EAM Non-US Small Cap	Trailing 4 Quarters
Market Impact (bp)	14.5
Peer Universe Market Impact (bp)	(0.34)
Net Market Impact (bp)	**14.8**
EAM Peer Rank	4%
Commission (bp)	(6.2)
Commission Universe (bp)	**(8.1)**
Net Commission Benefit (bp)	**1.9**
Total EAM Benefit (bp)	**16.7**

Source: Global Trading Analytics based on quarterly data for the 2023 calendar year.

Implementation shortfall is another method commonly utilized for evaluating trading costs. It compares the arrival price (when the trade decision is made) to the actual transaction price (the price at which the asset is ultimately bought or sold), measuring the difference or "shortfall". Implementation shortfall captures both implicit and explicit costs, including timing costs (costs associated with delays between decision and execution) and opportunity costs (costs incurred when the desired price is not reached due to delays in execution), thus provides a holistic view of trading efficiency.

The below implementation shortfall analysis measures the total cost of trading for EAM's US Small Cap and Non-US Small Cap strategies for calendar year 2023. In US Small Cap, the total average cost per trade was 50.6 basis points, ranking in the top quintile (14%) compared to peers. For Non-US Small Cap, the cost was 27.5 basis points, ranking in the top decile (4%) compared to peers. These real-world costs compare favorably versus academic estimates and are more in-line with recent practitioner data.

In our paper titled, "Momentum and Quality", we found that the annualized excess return of a long-only momentum strategy versus the market return in US small cap (1963 to April 2024) was 570 basis points annualized (without frictional costs). Based on the same 60-year data set, we can calculate a median calendar year excess return of 513 basis points and an arithmetic average of 609 basis points. Assuming approximately 200% turnover for our strategies, our total costs of implementation can be estimated at 151 basis points (cost per trade x turnover + assumed management fee of 50 basis points), low enough to preserve a significant piece of the theoretical momentum premium[3] no matter how you measure (mean, median, annualized). Similarly, in that same paper, we found the annualized excess return to a non-US small cap momentum strategy (1991 to April 2024) was 561 basis points (calendar year median 618 basis points and mean 629 basis points) versus our total costs of implementation of 105 basis points, which again includes an assumed management fee of 50 basis points.

Implementation Shortfall

EAM US Small Cap	Trailing 4 Quarters
Implementation Shortfall (bp)	(44.6)
Peer Universe IS (bp)	(50.2)
EAM Peer Rank	14%
Commission (bp)	(6.1)
Commission Universe (bp)	(8.0)
Net Commission Benefit (bp)	**1.9**
EAM Total Cost (IS + Commission)	**(50.6)**

EAM Non-US Small Cap	Trailing 4 Quarters
Implementation Shortfall (bp)	(21.4)
Peer Universe IS (bp)	(35.9)
EAM Peer Rank	4%
Commission (bp)	(6.2)
Commission Universe (bp)	(8.1)
Net Commission Benefit (bp)	**1.9**
EAM Total Cost (IS + Commission)	**(27.5)**

Source: Global Trading Analytics based on quarterly data for the 2023 calendar year.

[3] Assumptions: The momentum premium will exist in the future; Calendar year 2023 is a reasonable representative trading costs analysis; Actual average annual turnover for EAM US Small Cap and EAM Non-US Small Cap since inception has been 209% and 207%, respectively.

Conclusion

While academic studies have highlighted the impact of trading costs on momentum strategies, particularly for small cap stocks, recent practical insights suggest that these costs may be far lower than previously estimated. Advancements in trading technology, such as algorithmic trading and smart order routing, have significantly reduced execution costs, making momentum strategies more scalable and profitable than earlier academic models predicted. As evidenced by firms like AQR and BlackRock, real-world implementation of momentum strategies, when executed with a focus on liquidity and cost optimization, can indeed preserve the momentum premium. EAM founders' own experience over nearly three decades further demonstrates that with careful management, momentum investing can thrive despite the challenges posed by trading costs. Therefore, the gap between academic theory and practical execution appears to be narrowing, suggesting that momentum strategies remain viable and profitable when trading costs are carefully controlled.

About EAM

EAM Investors is solely focused on delivering alpha for clients in global equity markets. A momentum-driven approach to investing leverages their collective insight within a systematic process designed to deliver consistent and predictable outcomes. EAM's Informed Momentum® investment process has been applied consistently across all strategies since inception of the firm in 2007.

About the Authors

Travis Prentice

Travis is CEO and Chief Investment Officer of EAM Investors, a firm he co-founded in 2007. In addition, he is Portfolio Manager for EAM's US and Global strategies, as well as an analyst across all EAM's strategies. Prior to founding EAM, Travis was a Partner, Managing Director and Portfolio Manager with Nicholas-Applegate Capital Management where he had lead portfolio management responsibilities for their Micro and Ultra Micro Cap investment strategies and a senior role in the firm's US Micro/Emerging Growth team. He has 27 years of institutional investment experience specializing in momentum-based strategies. He holds an MBA from San Diego State University and a BA in Economics and a BA in Psychology from the University of Arizona.

David Wroblewski, PhD

David is Director of Applied Research at EAM Investors. Prior to joining EAM in 2021, David was Director of Research at Denali Advisors, an institutional equity manager with US and Non-US strategies. He has additional experience in research and risk management from Nicholas-Applegate Capital Management. David also serves as an Adjunct Instructor in the Department of Mathematics at San Diego City College. He has over 17 years of investment experience. David received a Ph.D. in Mathematics at the University of California, San Diego, a Master of Science in Applied Mathematics and a Bachelor of Science in Applied Mathematics from San Diego State University. David has published papers in the Journal of Investment Management, Financial Analyst Journal, and Applied Economics, among other financial publications. He has been awarded the "Harry M. Markowitz, Special Distinction Award" from The Journal of Investment Management.