



Transactions Costs: Practical Application

Executive Summary

Transactions costs are a necessary aspect of implementing any investment strategy, whether active or passive. When evaluating investment strategies, the analysis of transactions costs is at risk of being overly simplified, leading to potentially erroneous conclusions about a manager's trading acumen and ultimately suboptimal investment allocation decisions. The goal of this paper is to uncover the many nuances underlying transactions costs analysis and the implications of them when comparing costs across managers. It also presents a practical guide for due diligence pertaining to transactions costs that is meant to make the analysis more substantive.

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Introduction

Transactions costs are an inevitable and critical aspect of implementing any investment strategy, including “passive” ones such as index strategies (Pederson 2018). From the seat of the investor, however, understanding transactions costs when evaluating investment strategies can be a very challenging task. Here, we offer some guidance to help make discussions about transactions costs more substantive. We discuss the practical aspects of measuring transactions costs and the pitfalls one might face when trying to compare costs across managers. As we walk through

these topics, we importantly conclude each section by highlighting the key questions investors should pose to their managers. These questions serve as an evaluation framework to aid in generating meaningful comparisons across managers. Absent such a framework, investors are left with only naïve comparisons that can be misleading and result in suboptimal investment choices. By bridging this gap, this paper seeks to serve as a resource for creating effective dialogue around understanding and evaluating managers’ transactions costs.

Components of Transactions Costs

Managers should generally be able to define their methodology and process for measuring transactions costs, as well as how they optimize the implementation of their investment strategies, when considering transactions costs. Much literature has been dedicated to this topic, **from the framework proposed by Perold (1988),** to more recent studies that aim to estimate trading costs associated with specific strategies **(e.g., Frazzini, Israel, and Moskowitz 2012).** These works have significantly helped managers better understand the impact of trading on portfolio returns. However, because no standardized industry convention exists for defining or reporting these costs, managers and third parties may present the overall transactions costs for any given investment strategy in many different ways.

It is important to begin analyzing transactions costs by first breaking them down into

explicit and implicit costs. Explicit costs are generally known before a trade occurs and are more clearly measured and easily accounted for. **Examples of explicit costs include commissions, taxes, and fees.**

Implicit costs, in contrast, are harder to measure, as these generally relate to the impact trading has on market prices during and after execution. **Implicit costs include such concepts as spread and slippage versus a reference price. (Appendix A provides more details on these concepts.)** Clearly, if some managers only provide explicit costs to their investors, while others provide both, those who only provide explicit costs may incorrectly appear more skilled.

As we will now see, receiving summary figures only scratches the surface of understanding transactions costs and is but the first step in evaluating manager trading skill.

Explicit Costs

A Simpler Point of Comparison, but Not Simple

Explicit costs, such as commissions, fees, and taxes, are observable costs that can easily be measured. They generally have a proportional relationship to trade size. Because they are readily available and part of standard reporting frameworks, managers can typically provide these costs to investors with relative ease.

When analyzing explicit costs, commissions are usually the focus. Commissions are paid to financial intermediaries, such as executing brokers, prime brokers, and futures commission merchants (FCMs), primarily to pay for transacting in a specific security, such as a listed equity, or a contract, such as a bond future.

Generally, commissions are negotiable, and managers can use their size and trading volumes to lower costs. That said, it is important to note that some counterparties with less experience and less developed capabilities may offer lower commissions in an effort to grow their businesses and gain market share. Achieving lower commissions by using such a provider may expose the manager, and ultimately the end-investor, to greater counterparty and operational risks. In such circumstances, obtaining lower commission rates may not be the most optimal, as investors may not be suitably compensated for the additional risk they bear.

In some cases, to gain operational or cost efficiencies, managers choose to combine execution and clearing with the same provider. In these cases, commission rates can be negotiated alongside counterparty terms, which may include provisions governing limits, margin, and termination. It is important that the strength of these terms is not diminished when negotiating lower commissions, and also that the manager maintain a competitive process to serve as a check against unfair cost structures.

Commission rates can also be negotiated alongside “soft dollar” arrangements or additional services, such as access to research, market data, or high-touch (e.g., not wholly electronic) execution capabilities.¹ In these cases, it should be clear whether or not managers are outsourcing trading to brokers and, if so, what associated costs are passed along to the investor. If managers use soft dollars, they should be able to demonstrate to investors the cost effectiveness of the arrangement and how it maximizes benefits to the end investor. We also note that newer regulations, such as MiFID II, now serve to enhance transparency around these arrangements by requiring reporting of the additional costs associated with such services.

In some cases, commission rates are not directly measurable. The most common example is the use of swaps in investment strategies. In this case, commissions are added to the execution price rather than being

1 These of course would have to satisfy the safe-harbor provisions in Section 28(e) of the Securities and Exchange Act of 1934, as amended (15 U.S.C. § 78bb(e)).

separately reported, so managers would have to “back them out” based on information from underlying markets and proactively report these to investors. Otherwise, these costs would likely be excluded from commission costs and actual explicit costs may be understated.²

In addition to brokerage commissions, fees and taxes are components of explicit trading costs. Fees include those charged by exchanges and clearing counterparties to ensure proper settlement, as well as regulatory and data fees. Examples of taxes include those charged on the purchase of equities in some countries. Managers may use swaps to maximize after-tax returns for investors,

as well as to reduce counterparty or other risks from facing some exchanges directly. More specifically for futures, managers can purchase exchange memberships on behalf of their funds in order to gain significant savings on exchange and clearing fees.

When comparing managers, explicit costs, particularly commissions, may be more standard to report and compare. However, trade-offs between commissions and counterparty risks and terms should be evaluated, as should soft dollar arrangements and efforts to reduce trading fees. Evaluating these additional elements can help create a more complete picture of these costs and how they are managed.

Key Questions to Ask Managers:

- How are counterparty terms affected by the commission rates you report?
- Do you use soft dollar arrangements, and if so, how do these help maximize benefits to end investors?
- Do commission expenses include implied commissions from swap transactions?
- What additional measures are taken to optimize underlying fees and/or taxes?

² Managers may choose to incorporate these costs into their implicit cost calculations (which will be discussed later in this paper) or in some other way. Most important is that these are captured, not necessarily where they are allocated.

Implicit Costs

Many Approaches: All Defensible, All Problematic

The very label “implicit cost” suggests that such costs are not directly observable but embedded or implied, thus they are likely more difficult to both define and measure. In Appendix A, we delve deeper into the conceptual building blocks of implicit costs, and show how such measures are often “noisy,” making it hard to evaluate trading skill. Further, the difficulty in evaluating implicit trading costs is compounded by the lack of an industry standard and the tendency to sometimes adopt a “one-size-fits-all” approach. However, as we discuss, the appropriateness of some measures may depend on the circumstances in which they are being used, and we provide some guidance on ways to compare this aspect of transactions costs across managers.

Despite the ambiguity in measuring implicit costs, managers can still apply the underlying concepts to their strategies. We underscore that this is the primary purpose of dedicated transactions costs analysis — that by quantifying and understanding the transactions costs of a given strategy, managers can build trading solutions that strive to minimize these costs and achieve the best possible net returns for their investors. We will discuss this point in more detail later, but first, we will explore approaches used to compare reported implicit costs across managers.

As compared with explicit costs, implicit costs tend to exhibit significantly more variability across managers. Generally, implicit costs are measured as the difference between a transacted price and a reference or benchmark price based on market data.³ Much of the variability comes from manager discretion in choosing the benchmark methodology, but even when using the same methodology, significant differences can exist.

We will first cover two of the most common benchmark methodologies, volume weighted average price (VWAP) and pre-trade price, and discuss the trade-offs of using each. We will then also discuss benchmarking trades to market closing prices. Appendix A provides more detail on VWAP and pre-trade prices, and the next sections assume familiarity with the concepts.

VWAP vs. Pre-Trade Price

VWAP-based and pre-trade price based measures are two of the most commonly used measures in reporting implicit costs. However, they can be significantly different measures, and it is important to understand why that is.

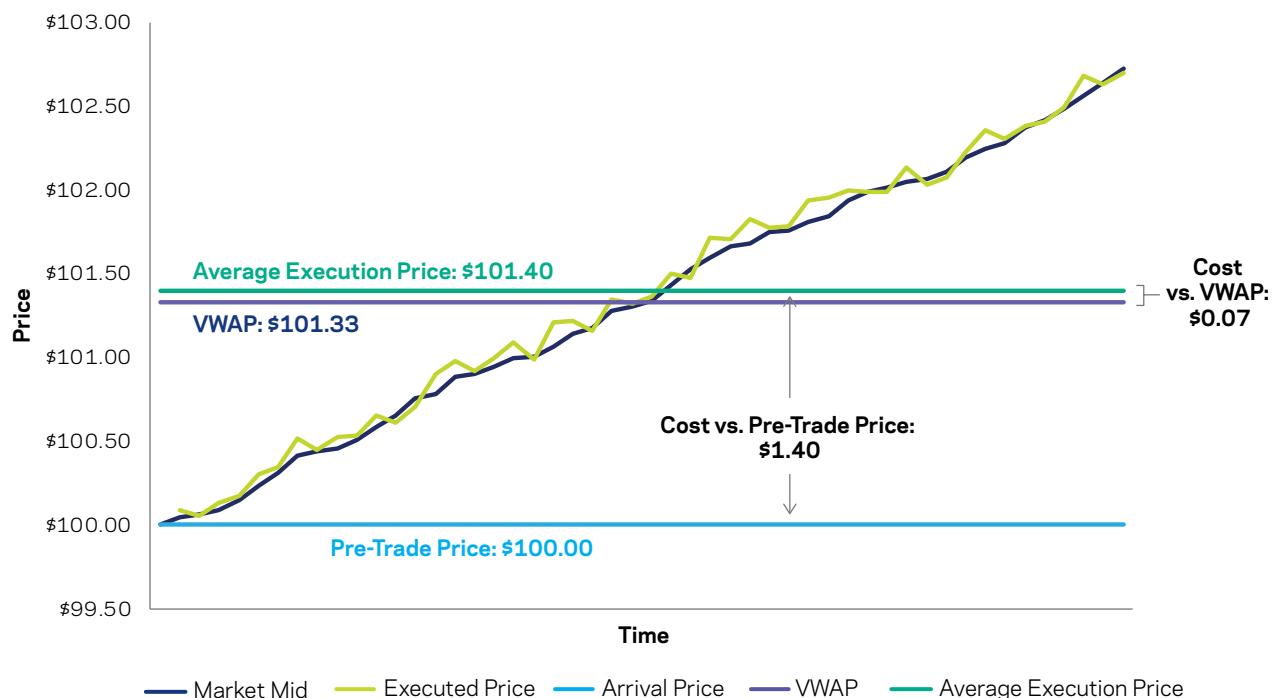
Let’s ask the question: Does an implicit cost of \$0.07 reflect better execution than an implicit cost of \$1.40?

That question cannot be answered without first understanding the measure(s) being used to calculate each number. *Exhibit 1*

³ The term “benchmark” is commonly used when discussing transactions costs analysis. However, as described in Appendix A, unlike standard and well-defined benchmarks in traditional markets, such as the S&P 500 Index, the price benchmarks described are generally not standardized nor readily accessible.

Exhibit 1

Measuring Transactions Costs: VWAP vs. Pre-Trade Price



Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

shows a trade being executed over a trading session in a hypothetical market. The market's mid price (i.e., the price in the middle of the observed bid and ask prices) and the execution price are plotted.

Determination of the implicit trading cost requires the choice of a reference price. We show the execution price of a single trade compared against both the VWAP and the pre-trade price, and we can see that the trade is much closer to the VWAP. This result is generally to be expected because the VWAP incorporates all the price changes over the execution period, while the pre-trade price does not account for subsequent market moves over the course of the execution.

Even for the same trade, the two different methodologies for measuring implicit costs can yield very different results. As illustrated in Exhibit 1, a manager benchmarked to VWAP may appear to have superior skill in achieving lower trading costs than one benchmarked against a pre-trade price, but the difference is in the measurement methodology and not trading skill. In actuality, the data presented here do not include enough information to allow for a fair apples-to-apples comparison.

Either of these methods isn't necessarily a "right" or "wrong" benchmark, but there are pros and cons to using each. For example, when a manager is only a small percentage

of trading volume, a VWAP benchmark may be appropriate as it accounts for the effect of general market moves that were likely not caused by the manager. However, when a manager is a larger part of trading volume, a pre-trade price benchmark can be more appropriate as the manager is more likely to impact the overall market during trading. This would impact a benchmark like VWAP, while a pre-trade benchmark is not influenced by the execution itself. The choice of benchmark should also consider the alpha decay of the strategy, which is a point we will discuss in a later section. A full discussion of both benchmarks and their appropriateness can be found in Appendix A. The most important insight here to consider is that comparing implicit transactions costs data across managers requires consistency in the benchmark methodology.

Benchmarking to the Closing Price — Inadvisable for Measuring Market Impact

Another methodology sometimes used for implicit costs involves benchmarking trades to a closing price. This methodology is sometimes used for products that provide exposure to alternative strategies in swap form. Often, costs measured using this methodology are calculated to be at or near zero due to the timing of orders versus the market close, and sometimes the party executing orders may guarantee to match the closing benchmark price. This can make a closing price benchmark attractive for investors who have to report transactions costs to their underlying clients or governing committees, but in actuality, accepting this arrangement can lead to lower net performance for the investor, as we will show later. The main issue is that the closing price is obviously determined after orders are executed and so includes the effects of their

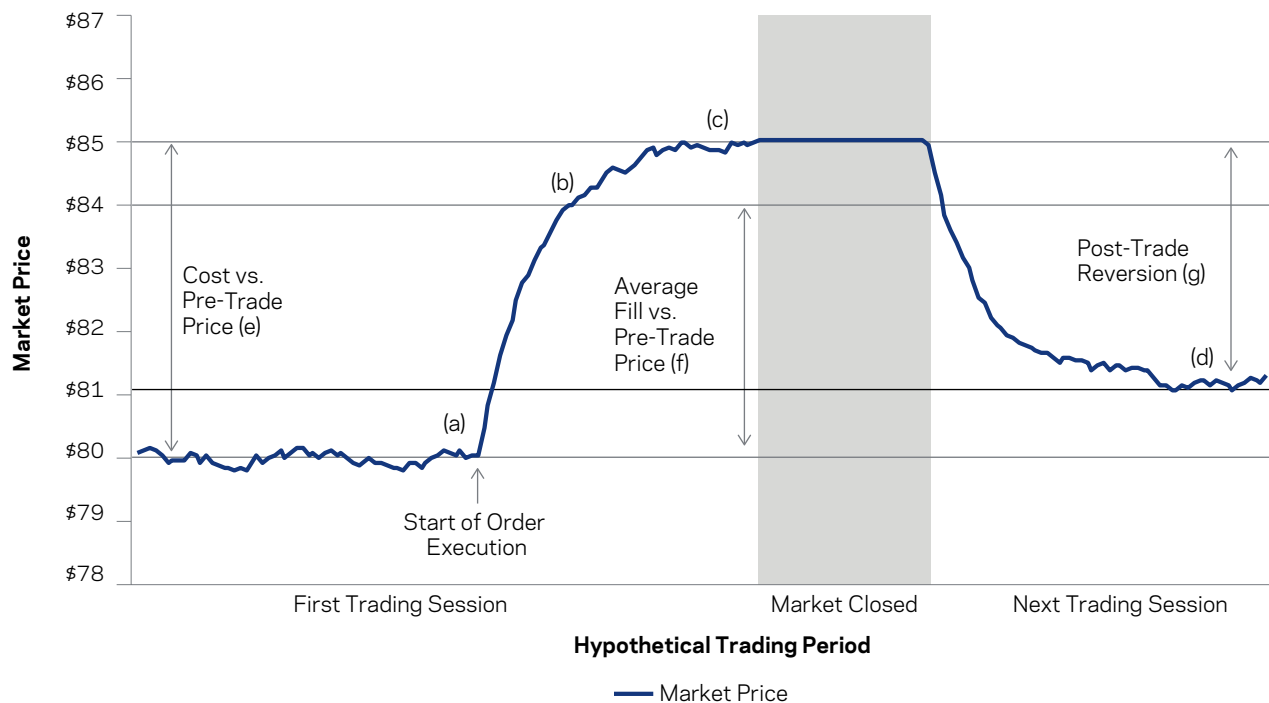
execution. Even though the measured costs using this approach may appear low, true impact to investors could be much higher, as Exhibit 2 demonstrates.

Exhibit 2 shows an asset's price over the trading session, as well as the pre-trade price just prior to the period over which the buy trade will be executed. As the exhibit shows, the price increases over the first trading session as market impact accumulates, but because that price itself is used as the benchmark, the reported implicit cost is zero. However, when the average fill price is compared with the pre-trade price instead of the closing price, it becomes apparent that the actual implicit cost of the trade is in reality far above zero. The execution has influenced the benchmark, hence making that benchmark inappropriate for evaluating trading skill. The example also shows that the market price falls at the beginning of the next session, as would be expected given the large market impact caused by the trading that took place during the first trading session.

As mentioned earlier, the party executing orders may offer to guarantee orders to be filled at the closing price. Instead of accepting this arrangement, it's recommended that the investor should request orders be filled at the actual prices executed in the market. As you can see in *Exhibit 2*, the average fill price of the order is in fact lower than the closing price. This is because as the order is being executed, market impact will accumulate, with the final fills being near the closing price. The average fill price, however, will include fills from earlier on in the execution, when there was less market impact. Thus, it is expected that the closing price guaranteed to the investor will be higher than the price achieved by the party executing the order. In such an arrangement, the party

Exhibit 2

Measuring Transactions Costs: Pre-Trade Price vs. Closing Price



Relevant Prices

Pre-Trade (a)	80.05
Average Fill (b)	83.91
Market Close (c)	84.98
Post-Reversion (d)	81.25

Relevant Cost Measures

Guaranteed vs. Close	0.00
Guaranteed vs. Pre-Trade (e)	4.93
Average Fill vs. Pre-Trade (f)	3.86

Other Relevant Measurements

Post-Trade Reversion (g)	3.72
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Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

executing the order earns the difference between average fill price and closing price, thereby creating a perverse incentive for that party to actually maximize market impact, which can lower investors' net returns.

When offered a closing price benchmark to evaluate trading costs, it shouldn't be used. Instead, market impact measurement should be done using a pre-trade price benchmark as well as a measurement of post-trade reversion. The pre-trade price benchmark will allow the

investor to more effectively measure the impact of the trade, whereas measuring post-trade reversion will also help to indicate how much of the measured impact was temporary, due to aggressive trading on the part of the manager. Post-trade reversion and temporary market impact are important concepts in general for measuring transactions costs, and while an in-depth discussion of them is beyond the scope of this paper, it is particularly important to highlight these in the context of closing price benchmarks.

Same Benchmark, Different Reported Costs

There is no single best way to measure implicit transactions costs, but it is still important to understand the differences among the various approaches. Even if two different managers follow the same practice of using a pre-trade price benchmark, there can still be important differences in the definition of “pre-trade.” For instance, if there are multiple sub-orders belonging to the same investment decision, one manager may use a different pre-trade price for each of the sub-orders, “resetting” the price at the start of each sub-order, while another may benchmark all sub-orders to the same price, often corresponding to the time the original investment decision was made. *Exhibit 3* shows how for a hypothetical asset, resetting the

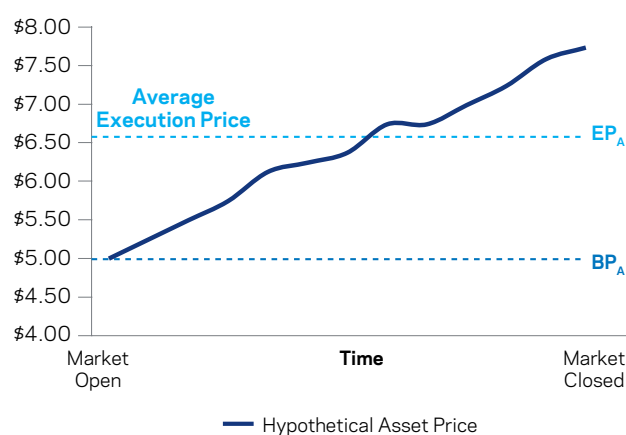
pre-trade price benchmark due to splitting an order leads to a lower estimate of transactions costs relative to using a single pre-trade price benchmark for the same order. The chart on the left, Method A, shows a hypothetical asset’s price throughout a trading session, as well as the pre-trade benchmark price (BP_A), and the average execution price (EP_A). The chart on the right, Method B, shows exactly the same asset and average execution price, but splits the trade into three sub-orders, each with its own benchmark price (BP_1 , BP_2 , and BP_3) and measures implicit trading costs relative to each using the average execution price in each sub-period (EP_1 , EP_2 , and EP_3). For each method, we show the calculation of implicit trading costs and illustrate how different applications of what seems to be the same benchmarking concept can lead to very different cost estimates for the same trade.

Exhibit 3

Differing Methodologies for Measuring Transactions Costs

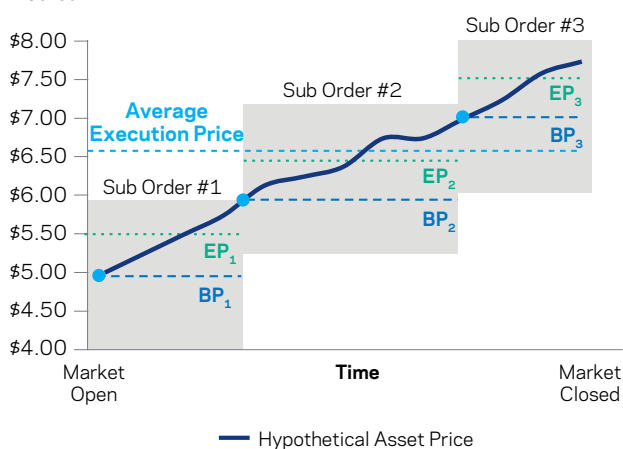
Hypothetical Upward-Trending Asset

Method A



Trade Number	Quantity	Average Price	Benchmark	Cost vs. Benchmark Price
1	120	\$6.60	\$5.00	\$192
Total:		\$6.60	\$5.00	\$192

Method B



Trade Number	Quantity	Average Price	Benchmark	Cost vs. Benchmark Price
1	40	\$5.50	\$5.00	\$20
2	40	\$6.55	\$6.25	\$12
3	40	\$7.75	\$6.90	\$34
		\$6.60	\$6.05	\$66

Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

Thus, even when using a pre-trade price benchmark, different managers may apply different calculation methodologies that yield different reported transactions costs. Importantly, there is not necessarily a right or wrong answer, and these different methods may reflect specific aspects of a manager's trading optimization process.

Understanding that these methodology differences may exist even using the same benchmark concept, when presented with costs across managers, an investor cannot immediately assume that differences are reflective of trading skill. Rather, it's best to dig deeper to see where variation may be a result of the specific methodology and understand why that approach was taken.

Lining Up Reported Costs

As is evident from the discussion in this section, the large amount of flexibility that exists in reporting transactions costs means that managers may not report costs in a way that is consistent from the perspective of the investor. However, managers, or the third-party providers they rely on, may have the capability to report costs in more than one way. Hence, when presented with costs across managers, one approach to help increase comparability is to see if alternative reporting can be done in a manner that aligns methodologies.

Key Questions to Ask Managers:

- Which benchmark is used to measure implicit cost?
- How is the appropriateness of the benchmark determined?
- How are sequential executions for the same investment decision benchmarked?
- Is the manager able to provide transactions analysis using a methodology useful to the investor to allow for appropriate comparison?

Capturing All Costs

In the course of managing a portfolio, trading activity and costs may be incurred unrelated to changes in the portfolio manager's market views. Some examples include foreign currency funding trades for equities, roll trades for derivative contracts, and other operational activity, such as currency sweeps as a result of dividends. Asking for an analysis incorporating all trading activity can help create a more complete picture.

An additional consideration would be any opportunity cost incurred from not executing a portion of orders. For example, if a buy order was only partially executed when the market was below the arrival price and subsequently the market rallied, the portfolio would not get the benefit of returns for the unfilled portion of the order. That would result in a large opportunity cost to investors that is likely not directly captured in a transaction cost analysis. To understand the potential impact of such activity on reported costs, a starting point would be to ask managers what portion of orders are not completed. The more frequently this occurs, the higher the potential opportunity cost from not executing orders.

In a further example, imagine a trader who will be evaluated based on the measured market impact of his trades. He is given a list of orders, which he is not required to fully execute. Given these conditions, the trader may choose to only execute the orders that can be done at favorable

prices (e.g., lower prices for buy orders) and leave the rest unfilled. Using this approach, the trader can guarantee a "negative" measured cost, which he may then represent as trading skill. What's missing in the picture is the opportunity cost in terms of forgone returns to the investor of the orders not executed.

Another interesting point here is that by not executing some orders, the trader is likely to get adversely selected. This means that he will typically get filled when there is opposing market interest and subsequent price moves are more likely to be against him. Conversely, he will not get filled when there are other participants who want to trade in the same direction, meaning the orders he does not get filled will likely keep on moving, translating into further lost opportunity for investors. While the concept of adverse selection warrants further in-depth discussion, it's worth highlighting here as it is important in cases where orders are not fully executed.

Hence, obtaining a complete estimate of transactions costs is a function of the effort an investment manager makes in creating and executing a framework for measuring and monitoring them. What is evident is that the methodology and resources for measuring transactions costs can vary even among managers implementing similar strategies, and the results may not be suitable for the purpose of assessing manager trading skill.

Key Questions to Ask Managers:

- Are all trades included?
- What is the percentage of trade orders not fully executed?
- Is the opportunity cost of trade orders not executed captured in transaction cost measures?

Maximizing Net Returns: A Balancing Act

What ultimately matters is not how much investors pay but how much they receive. In other words, the level of transactions costs alone is not enough to differentiate manager trading skill. Investment managers need to strike a fine balance between trading costs and the expected gross returns of their strategies to maximize the net-of-fee returns they deliver to investors. As we discuss in this section, this balancing act depends on several factors specific to each strategy.

The Role of Alpha Decay

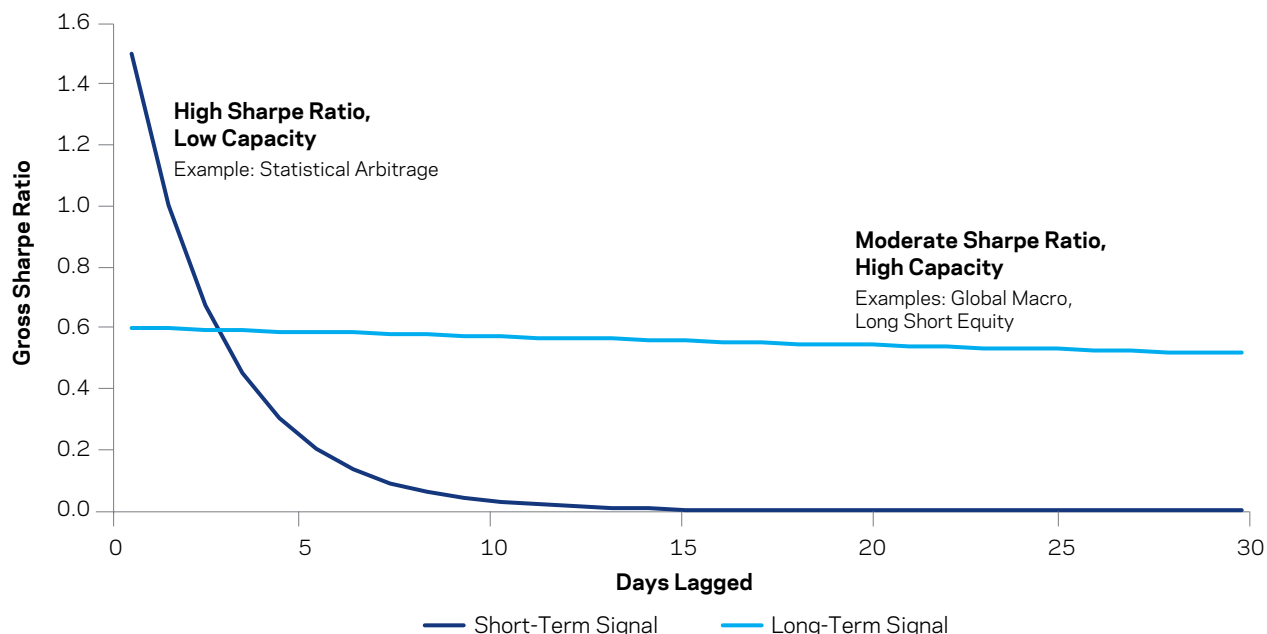
An important concept in the discussion of transactions costs is alpha decay. It refers to the expected degradation in a trade's performance due to a time delay between the initial signal and the actual execution.

The longer the time delay, the greater the alpha decay. Strategies vary in their alpha decay rates, thereby driving different optimal execution approaches and levels of transactions costs. *Exhibit 4* shows two different hypothetical investment strategies, each of which can be described by an expected Sharpe ratio and a capacity estimate. We see that high Sharpe ratio strategies exhibit lower capacity than moderate Sharpe ratio strategies. For both types of strategies, we see that waiting to execute over some number of days leads to a decline in the expected Sharpe ratio, although at different rates. As the time delay increases, however, the higher Sharpe ratio strategy exhibits a faster degradation of its expected Sharpe ratio than the moderate Sharpe ratio strategy. While these are hypothetical examples, in practice, investment

Exhibit 4

Alpha Decay Explained

Different Strategies Exhibit Different Alpha Decay Rates



Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

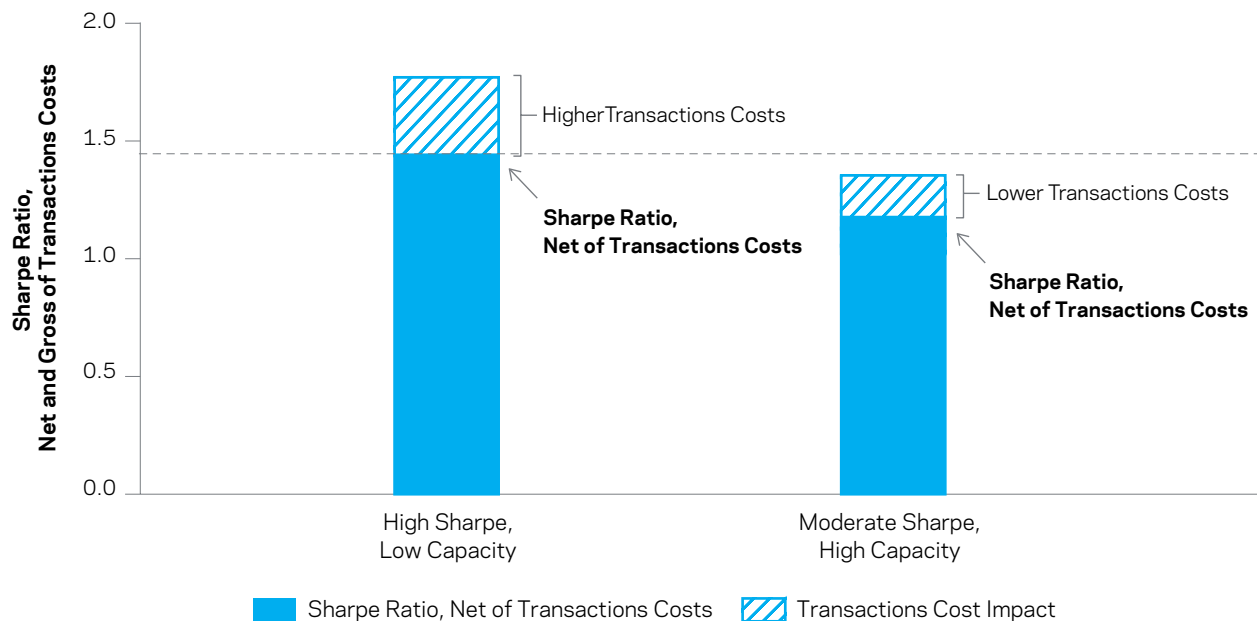
strategies tend to reflect these characteristics as well, with alpha decay rates being directly related to Sharpe ratios and both being inversely related to capacity.

Note that in this example, we are not taking into account transactions costs. We are only considering how a strategy's efficacy changes by waiting to implement it, assuming no transactions costs. What would the relationships shown imply for trading optimization? The example shows that the higher Sharpe ratio strategy does not afford much time to reap its benefits, and thus trading likely has to be more aggressive relative to the higher capacity, moderate Sharpe ratio strategy. Therefore, effective trading of the higher Sharpe ratio strategy would likely result in *higher* transactions costs relative to the moderate Sharpe ratio strategy. This doesn't mean the manager of the higher Sharpe ratio strategy necessarily has worse

trading skill, nor does it mean the end-investor will experience a worse return after taking into account transactions costs from investing in the higher Sharpe ratio strategy. Further complicating the analysis is the fact that differences in alpha decay rates can be exhibited not only across managers but also within a single manager, as a single manager may execute a number of underlying strategies with a range of alpha decay rates.

There is little one can infer about a manager's trading acumen from simply knowing how aggressively she trades or the level of transactions costs she incurs without understanding the strategy's alpha decay profile. From a practical perspective, comparing market impact costs from different managers that run different strategies might reveal vastly different figures for reasons that have nothing to do with execution ability but everything to do with the investment strategy itself.

Exhibit 5 Hypothetical Investment Strategies



Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

Exhibit 5 depicts how this trade-off might play out for two simulated strategies, such as those we just described. A higher Sharpe ratio, lower capacity strategy might exhibit higher transactions costs and also higher net returns versus a more moderate Sharpe ratio, higher capacity strategy that has lower transactions costs but also lower overall net returns. We find this relationship holds generally across many of the investment strategies we research.

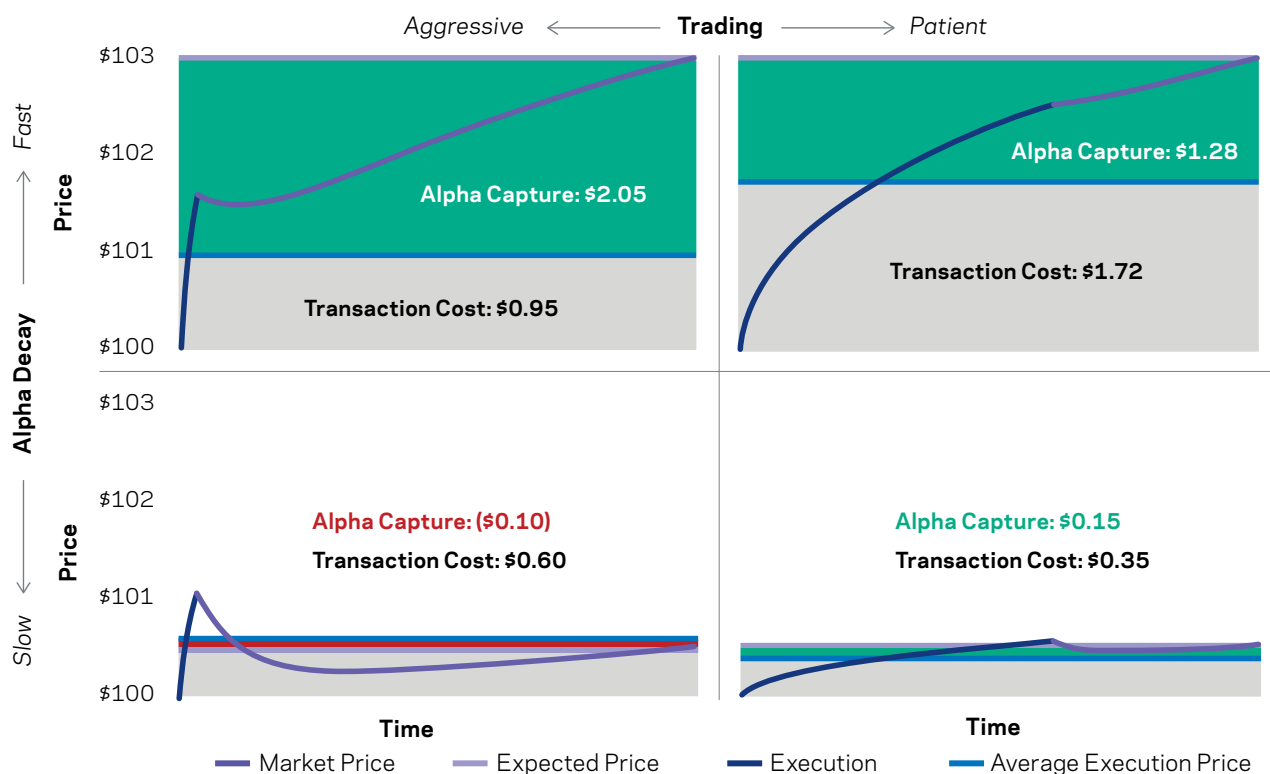
Hence, transactions costs figures alone may not be directly comparable across strategies or managers (even managers within the same category, such as long/short equity or managed futures, given the measurement considerations we described earlier) and looking solely at their differences alone may not be useful in assessing manager trading skill.

Lower Trading Costs Indicate Manager Trading Skill (for a Given Alpha Decay)

Evaluating manager trading skill begins with understanding the alpha decay rates of the strategy or of the range of underlying strategies, as the alpha decay rate has a major influence on the level of transactions costs the manager might incur in capturing the alpha being sought. By understanding the alpha decay profile of a strategy, we can better understand the optimization that takes place and then evaluate trading skill.

Exhibit 6 offers an approach to thinking about trade optimization in the context of alpha decay. For a strategy with a slow rate of alpha decay, the difference between being aggressive versus trading more patiently is

Exhibit 6
The Interaction between Alpha Decay and Trading Aggressiveness



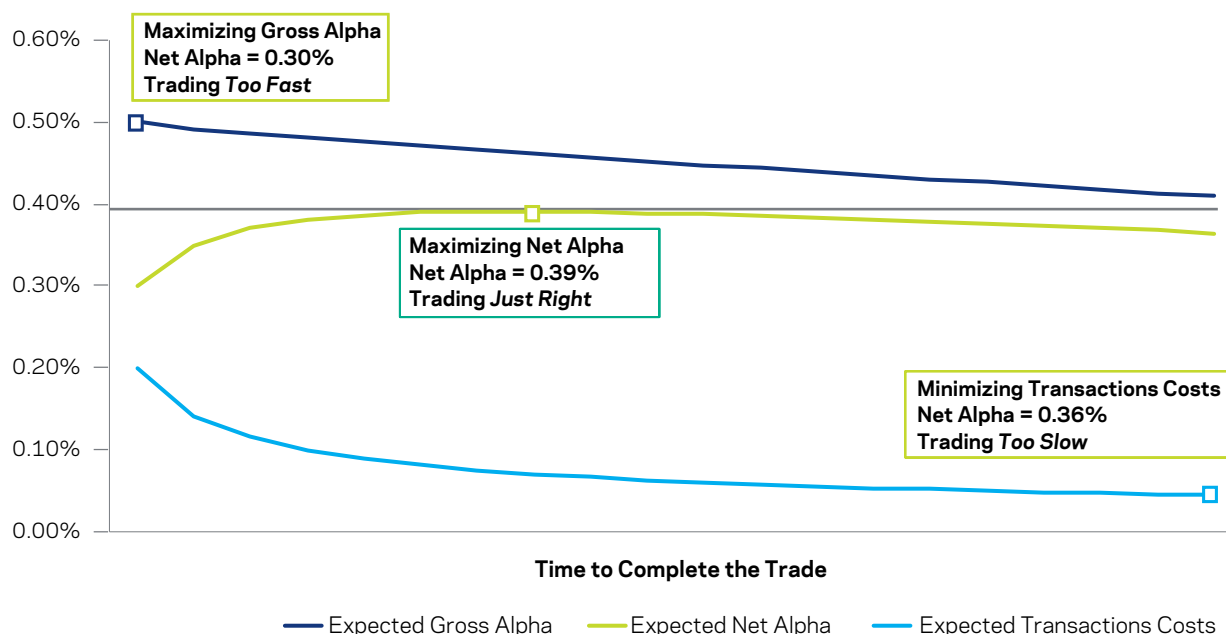
Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

shown in the bottom two quadrants of the schematic in Exhibit 6. Trading aggressively leads to greater market impact, which then unnecessarily reduces the alpha capture, whereas being patient allows the manager to capture the alpha the strategy offers. Conversely, for a strategy with a high rate of alpha decay and higher alpha, as shown in the top two quadrants, the faster and more aggressive the manager, the greater the original alpha that can be captured. Importantly, note that the more patiently a manager trades in this case, the higher the transactions costs (and lower the alpha capture). For the strategy with the fast alpha decay, the transactions costs the manager bears are higher than for a slower alpha decay strategy, but the manager captures more net alpha for investors. Hence, it would be misleading to evaluate manager trading skill by comparing transactions costs of trades in the top versus bottom quadrants,

and instead it is critical to first consider differences in alpha decay rates before making an evaluation. Only across managers with similar alpha profiles can lower trading costs be interpreted as indicative of superior trading skill.

Exhibit 7 depicts a simple example of this trade-off. It shows how the alpha decay profile of a trade combines with expected transactions costs to achieve the optimal net alpha. By focusing only on capturing alpha, the manager may trade too aggressively, capturing high gross returns. Similarly, by emphasizing the goal of lowering transactions costs, the manager may trade too slowly and give up some of the alpha of the strategy. It is only by focusing on net returns that the manager can make the appropriate trade-off between alpha decay and transactions costs. We believe that managers should have a dedicated process for ascertaining this

Exhibit 7 Trading Skill Is About Maximizing Net Alpha



Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

trade-off. Importantly, the process should also evolve as both strategies and markets evolve and should be thought of as an iterative and improving process.

The preceding examples hopefully help illustrate the concepts that investors should consider when thinking about evaluating levels of transactions costs across managers. It's also important to recognize that comparing levels of transactions costs absent an understanding of the manager's alpha decay profile reveals little about a manager's trading skill. In reality, understanding alpha decay can be even more complex as managers

might employ multiple signals or models with their own corresponding alpha decay rates. Manager trading skill is ultimately determined by how a manager makes the necessary trade-offs to maximize net-of-transactions-costs alpha to investors.

Thus, for the investor, it is important to approach manager evaluation by ensuring each has the appropriate processes in place to trade off the costs they incur against the alpha they aim to capture. Additionally, the investor should ensure that cost comparisons are only done in the context of similar strategies across managers.

Key Questions to Ask Managers:

- What is the alpha decay rate of the strategy?
- For the given alpha decay rate, what is a reasonable expectation of transactions costs for the strategy?
- How is the aggressiveness of trading determined?
- How are trade-offs between transactions costs and opportunity costs evaluated?

Conclusion

On the surface, it may seem that an attempt to conduct a serious transactions costs analysis may be impractical given the numerous nuances involved. We seek to provide guidance by breaking these costs down into explicit costs and implicit costs and discussing how to think about each in the context of an overall analysis. For example, explicit costs, while generally observable across managers, should also be evaluated in the context of counterparty risks and negotiated terms, as well as whether and how soft dollars are used. Implicit costs, for their part, come with far greater complexity and variability, and calculating them requires a reference price and measurement methodology that itself is likely to vary across managers. Additionally, because trading costs are necessarily incurred when accessing a strategy's alpha, the alpha decay profile of a strategy is an important consideration for both understanding and evaluating a manager's trading skills.

These complexities underscore the difficulty of having a single, simple and meaningful transaction cost metric that facilitates apples-to-apples comparisons across managers and strategies even when using the services of third-party transaction cost analysis providers. That doesn't mean, however, that investors

can't glean valuable insights from having an informed discussion about transactions costs with their managers. Our view is that these discussions, like most aspects of manager evaluation, should be grounded in a more holistic understanding of the team and process behind the investment strategy, because cost measurement is only one aspect of cost analysis. The discussions should focus on whether managers comprehend how material transactions costs are to their investment process and whether management of these costs is a core competency with a dedicated team to collect, clean, and analyze their data. Most importantly, the discussion should determine whether transactions costs are merely reported or also proactively fed back into the investment strategy's decision-making process.

At the end of each of the preceding sections, we've listed the key questions for investors to pose to investment managers to more accurately assess transactions costs. We hope this will serve as a handy framework for investors to garner important information they need on transactions costs to better make determinations of managers' alpha generating capabilities. For ease of reference, we have provided the full list of key questions here as well.

Summary of Key Questions to Ask Managers:

- What is the alpha decay rate of the strategy?
- How do your transactions costs break down between explicit and implicit?
- How are counterparty terms affected by the commission rates you report?
- Do you use soft dollar arrangements, and if so, how do these help maximize investment returns?
- Do commission expenses include implied commissions from swap transactions?
- What additional measures are taken to optimize underlying fees and/or taxes?
- Which benchmark is used to measure implicit cost?
- How is the appropriateness of the benchmark determined?
- How are sequential executions for the same investment decision benchmarked?
- Is the manager able to provide transactions analysis using a methodology useful to the investor to allow for appropriate comparison?
- Are all trades included?
- What is the percentage of trade orders not fully executed?
- Is the opportunity cost of trade orders not executed captured in transaction cost measures? What is the alpha decay rate of the strategy?
- For the given alpha decay rate, what is a reasonable expectation of transactions costs for the strategy?
- How is the aggressiveness of trading determined?
- How are trade-offs between transactions costs and opportunity costs evaluated?

Appendix A:

Primer on Measuring Implicit Transactions Costs

This section expands on some key concepts on measuring implicit transactions costs.

Spreads

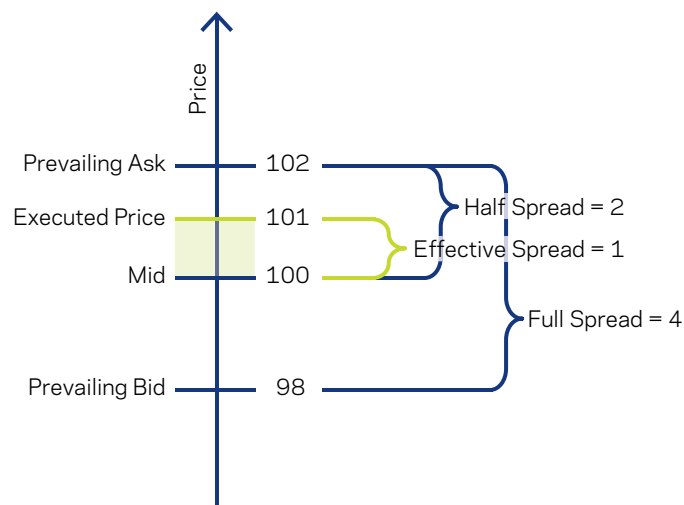
At the core of all markets is the concept of a “bid” price and “ask” price, corresponding to the prices that someone is willing to buy from you and sell to you, respectively. Each market transaction is the result of a buyer and seller coming together and executing at a price near the bid and ask. The bid and ask prices are provided by a price maker (often a market maker), who provides liquidity as a service and aims to earn the spread as compensation. A price taker will typically act on the bid or ask to complete a transaction.

The “mid” price is between the bid and ask. The most common spread measure is the difference between the transacted price and the prevailing mid prior to the trade. This is called the “effective spread.”

In *Exhibit A1*, a buyer has executed at a price of 101. The effective spread cost of 1 is the difference between the executed price of 101 and the prevailing mid price of 100, which itself is halfway between the bid and ask prices of 98 and 102, respectively.

The spread measure is popular because it is simple and straightforward to calculate.

Exhibit A1
Market Prices and Spreads



Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

It is most applicable when the full order is completed in a single execution, and when there are transparent pre-trade mid prices available. However, if these conditions do not hold, the spread cost can understate the full costs experienced by investors. For example, if a trade is executed in multiple pieces, it is possible that the market could move over the course of the execution, and this cost would not be captured in the effective spread cost. Another example would be that in many OTC markets, prices are not published. A manager must request quotes from a market maker, thereby revealing information that the market maker may use in preparing bid and offer prices.

VWAP

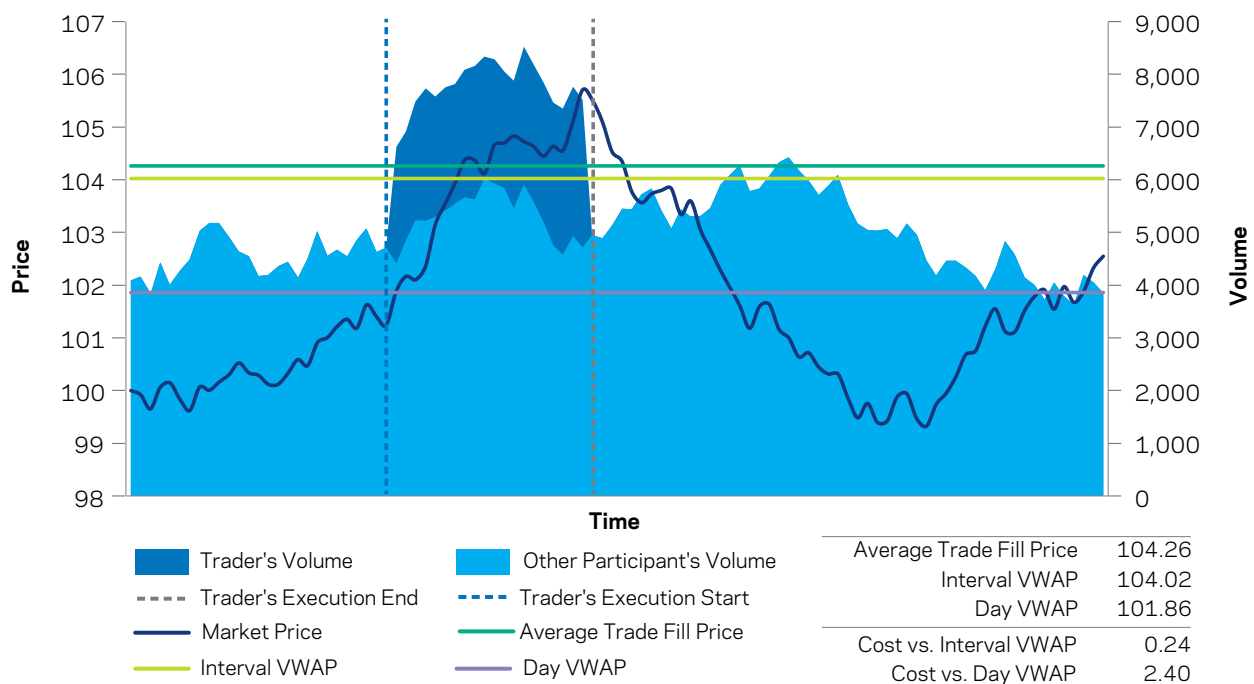
A very common method of measuring implicit costs is comparing the executed price against the VWAP (volume weighted average price). The VWAP, calculated as the average of the execution prices in a given period of time, weighted by their corresponding quantities or volumes, is readily available through a number of tools. Due to its accessibility and simplicity, it has become a prevalent benchmark for implicit costs. Managers typically compare their fill prices with the VWAP of the corresponding period of time in which they were executing an order.

However, this inherently means that the manager's trades are also part of the VWAP measure, and as a consequence, the benchmark also includes the manager's impact on the market. The interesting paradox this presents is that as the manager participates at a higher

rate in a given period of time, thereby having a larger impact upon prices, the manager's executions also become a larger portion of the VWAP measurement, and the manager's impact measured in this way diminishes. In the extreme case, if the manager is 100% of the volume in the period, their average execution price would be the period VWAP, and their cost versus the VWAP would be zero. However, their true impact on prices could be much larger. Thus, for the largest trades (defined relative to the instrument's corresponding trading volume), where it is most important to measure costs, VWAP is an ineffective benchmark.

Different VWAP benchmarks may be used, resulting in widely different estimates of transactions costs. For example, the manager could choose to use the VWAP of precisely the interval of the trade, or alternatively the full day's VWAP. In *Exhibit A2*, a trader is participating at a fairly high rate for a limited

Exhibit A2
VWAP Cost of a Single Trade



Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

period between hours 3 and 6. He completes his trade at an average price of 104.26, only 0.24 greater than the VWAP of the trading interval. Notice that prices increase during the period that he executes and revert subsequently. The interval VWAP does not capture this effect. However, when the fill price is compared with the full day's VWAP, a higher cost is measured, which better captures this effect. Regardless of these approaches, any VWAP benchmark that includes some of the manager's trading would be influenced by that activity and would therefore not fully capture transactions costs.

Pre-Trade Price

While a VWAP benchmark includes the effects of the trader's activity on the market, the pre-trade benchmark circumvents this issue. This benchmark involves using the prevailing market price prior to the start of any execution as the benchmark for the order. A few commonly used ones are the following:

1. *Decision price*: when the manager made the investment decision
2. *Arrival price*: when the manager handed the order over to the trader
3. *Start price*: when the trader began executing the order

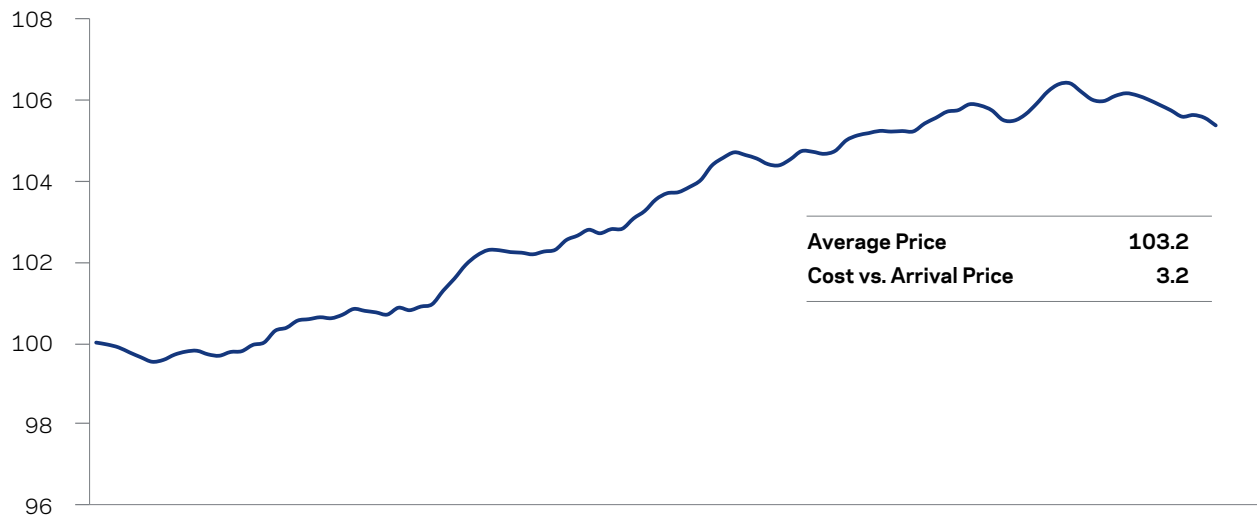
As these benchmarks are all determined prior to the start of execution, they are not influenced by the execution of the order. Additionally, they may capture costs incurred in various parts of the investment process.

For example, the decision price captures all price movements from the time the decision is made, whereas the arrival price captures the subset of price movements from when the trader is able to act on the order.

A common way to measure them is to use the market mid price prior to the start of execution, similar to how the effective spread is benchmarked. The difference, however, is that all the executions of the order are benchmarked against the same pre-trade price.

This measure of cost is the most inclusive and complete, as all implicit costs (i.e., spreads as well as impact upon the market) are captured. However, it has the disadvantage of having the largest variance in measurement because it incorporates all other changes in the market, many of which will be entirely unrelated to the particular execution. For example, if a trader executes a buy order while the market as a whole is rising, it will reflect a larger cost than that attributable to the trade alone. Conversely, it is also possible for the cost measurement to be negative if the market as a whole is falling while a trader is buying. As a result, managers often need to average across a large number of trades to make a more reasonable determination of the transactions costs.

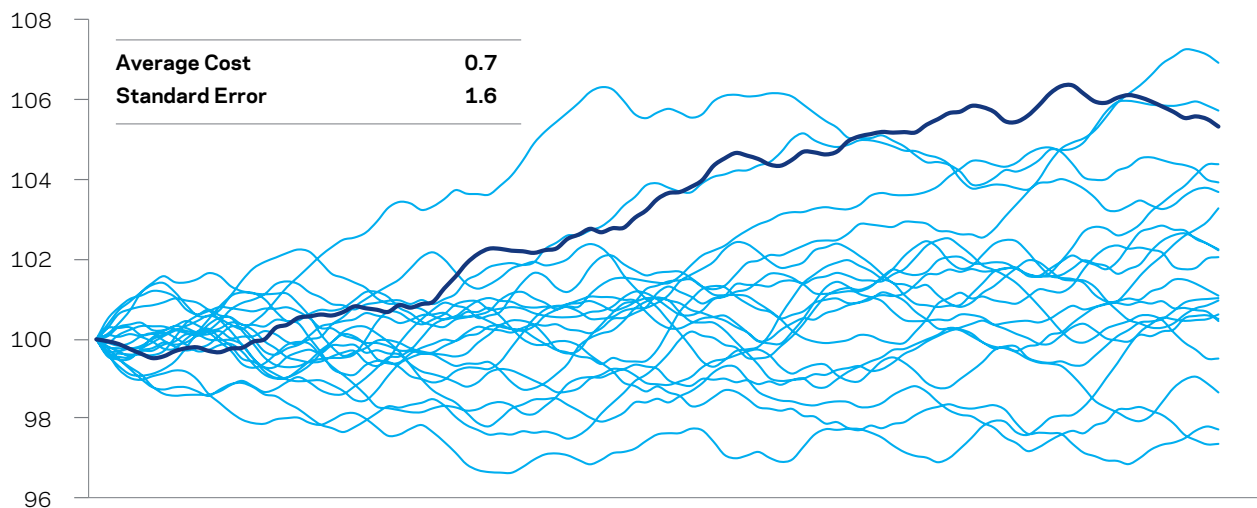
In *Exhibit A3*, the trader is buying throughout the period as the price gradually drifts up. Although there is a large move against the trader, it would not be correct for the manager to expect to realize similar costs in the future.

Exhibit A3**Cost vs. Arrival Price of a Single Trade**

Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

Exhibit A4 adds many more trade observations and shows how “noise” can enter into the measurement. There are a number of large positive measurements, but also a handful of negative ones. Although the average cost of these trades is now lower than

that of the first trade considered in isolation (and still a positive number, which is to be expected), the standard error of the measured observations shows that it is not statistically significantly different from zero.

Exhibit A4**Cost vs. Arrival Price of Many Trades**

Source: AQR. For illustrative purposes only and not representative of actual portfolio trading, nor does it indicate the possibility of profits or losses within a portfolio.

When using a pre-trade price benchmark, managers often need hundreds or thousands of observations to make a reliable assessment of their true costs. The measured cost incurred by the portfolio can vary widely from one year to the next. For this reason, using a pre-trade measure is often less popular than a VWAP-based measure.

Using a pre-trade price also has its own paradox: The slower a manager trades, the lower is his expected impact on the market, but the higher the noise of the measurement. This is because the longer the duration of the execution, the more likely it is for unrelated events to influence the price of the security being traded.

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