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A Methodology for Measuring Transaction Costs

In an investment environment where 100 basis points can mean the difference between outperforming and underperforming a benchmark, careful management of costs can yield tremendous dividends. To manage costs effectively, however, investors need a monitoring system capable of capturing and analyzing all data pertinent to the transaction process. Such comprehensive data are critical to a better understanding of the sources of trading costs and their impact on performance.

Transaction costs include commissions, execution costs and opportunity costs. Commissions are fixed and measurable over a period, but execution and opportunity costs are neither fixed nor directly measurable. While there exist various accepted methods for estimating these costs, no one approach is the best in all circumstances. It is thus important to monitor price behavior over the entire transaction process, from the point at which a decision to implement an investment strategy is made through the time a decision is made to change it.

Minimizing trading costs involves identifying the optimal tradeoff between execution costs and opportunity costs. Each investment strategy or style has its own opportunity cost function. Some strategies facilitate patient trading, while others require immediate and aggressive trading.

THE COST OF implementing an investment strategy is an integral part of the investment process, having a direct impact on investment performance. Consequently, both the *decision* to trade and the *ability* to trade are important considerations when developing an investment strategy. Any choice to transact must weigh the investment criteria, the cost of transacting and the opportunity cost of not transacting.[1]

Transaction costs consist of commissions, fees, execution costs and opportunity costs. While commissions and fees are readily measured, execution costs and opportunity costs are not. Execution cost, for example, represents the difference between the execution price of a security and the price that would have existed in the absence of the trade. As these two conditions cannot exist simultaneously, true transaction costs are inherently unobservable. There are cost measures that can provide useful information for the money manager, but we believe that no single measure tells the whole story. A set of measurement benchmarks is needed to capture the entire transaction process.

This article proposes a methodology for analyzing the transaction process. The objective is to provide investors with a framework for evaluating the transaction process, one that can be used to minimize transaction costs. This approach requires a real-time-based system that monitors both asset performance and various transaction-cost-related data.

Defining Transaction Costs

It is generally agreed that investment costs (net of research costs) have a fixed component and a variable component. The fixed component is easily measured, as it consists of *commissions* charged by brokers, *taxes* and *transfer fees*.[2] Unfortunately, the fixed component is much

1. Footnotes appear at end of article.

Glossary

Implementation Costs: Transaction costs; the total cost of implementing an investment strategy including execution costs, opportunity costs, commissions and fees.

Market Impact: The movement in the price of an asset that is the result of a trade plus the market-maker's spread; also called price impact.

Market Timing Cost: The movement in the price of an asset at the time of a transaction that can be attributed to other market participants; it can be positive or negative.

Opportunity Cost: The performance shortfall of an investment strategy resulting from a failure to execute all desired trades at the desired time.

Informationless Trades: Trades that are the result of the reallocation of wealth or the implementation of an investment strategy that utilizes only current information; rebalancing an index portfolio is an example.

Rebalancing Trades: Trades that are motivated by the desire to duplicate the performance of a benchmark portfolio and not by the entrance of new information into the marketplace.

Implied Execution Cost: The cost per share of buying or selling a portfolio of stocks implied by the difference between the market value of a benchmark portfolio at the time of execution and the market value of the actual portfolio based on execution prices.

smaller than the variable component, and the latter is much harder to measure.

The variable component consists of *execution costs* and *opportunity costs*. Execution costs can be further decomposed into price, or *market impact*, and *market timing* costs. Market impact reflects the bid/ask spread plus a price concession that compensates the buyer or seller for the risk that the investor's transaction is information-motivated. Market timing costs arise when, during the time of the transaction, the asset's price moves as the result of activity other than the particular transaction.

Opportunity costs are defined as the difference between the performance of an actual investment and the performance of a desired investment, adjusted for fixed costs and execution costs. This performance differential reflects the cost of not being able to implement all desired trades. Table I summarizes the components of transaction cost.

Execution Costs

Execution costs arise out of the demand for immediate execution and reflect both the demand for liquidity and the trading activity on the trade date. Execution costs may vary with investment style and the trading demands of the investor. There is, for example, a distinction between information-motivated traders and informationless traders.[3]

Information-motivated traders believe they possess pertinent information not currently reflected in a stock's price, hence wish to trade as quickly as possible. This style of trading tends to have a relatively large price impact both because the trader is more concerned with the time at which the trade is executed than the price, and because market-makers may demand price concessions when they suspect a trader is motivated by information they do not possess.

Informationless traders trade to reallocate wealth or to implement an investment strategy that uses only information already impounded in stock price. Examples include a pension fund's decision to invest cash in the stock market, or to rebalance a portfolio or to liquidate. Informationless trades generally have a smaller price impact than information-motivated trades, because the demand for liquidity is less and they should not lead market-makers to demand significant price concessions.

The problem with measuring execution costs is that the true measure—the difference between the price of the stock in the absence of the trade and the actual execution price—is not observable. Furthermore, execution prices are dependent on supply and demand conditions at

Table I The Components of Transaction Costs

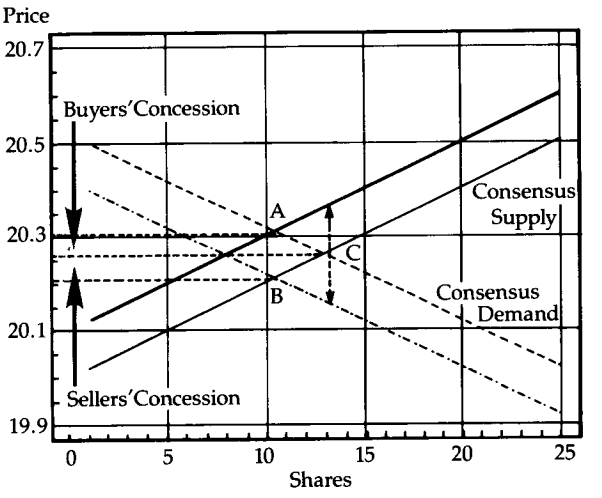
Investment Costs = Research Costs + Transaction Costs
Transaction Costs = Fixed Costs + Variable Costs
Fixed Costs = Commissions + Transfer Fees + Taxes
Variable Costs = Execution Costs + Opportunity Costs
Execution Costs = Price Impact + Market Timing Costs
Opportunity Costs = Desired Returns − Actual Returns − Execution Costs − Fixed Costs

the margin. The execution price may, for example, be influenced by competitive traders demanding immediate execution or by other investors with similar motives for trading. This means that the execution price realized by an investor depends on the structure of the market mechanism, the marginal investor's demand for liquidity and the competition from other investors with similar motivations for trading.

Figure A illustrates this process. Here the consensus price equilibrium (point C) cannot be achieved if execution must be immediate.[4] Immediate execution requires a price concession, represented by the shift in the demand and supply curves. Point A represents the price at which an investor can purchase stock immediately; it is defined by the intersection of the supply curve of investors who are prepared to sell stock immediately and the consensus demand curve. Point B represents the price at which an investor can sell stock immediately.

The illustration is a static representation of the execution process. In actual markets, a set of curves represent various levels of liquidity and price concessions. In general, the more liquid the security, the smaller the shift in the demand and supply curves. Moreover, the supply and demand for any security is a dynamic process. As the demand for immediate execution falls, however, the supply and demand curves will collapse on the equilibrium price. For example, the demand for immediate execution is low for investors who have low opportunity costs.

Figure A The Cost of Immediacy



Opportunity Costs

The cost of *not* transacting represents an opportunity cost.[5] Opportunity costs may arise when a desired trade fails to be executed. They represent the difference between the performance of the desired investment and the actual investment, after adjustment for execution costs and commissions. Opportunity costs have been characterized as the "hidden" cost of trading, and some have suggested that they account for the shortfall in the performance of many actively managed portfolios.[6]

The measurement of opportunity costs is subject to the same problems as the measurement of execution costs. The true measure can be calculated only if one knows what the performance of a security would have been had all desired trades been executed at desired times across an investment horizon. Because these desired trades are the ones that could not be executed, opportunity costs are inherently unobservable. Nevertheless, one can monitor the performance of desired investments *as if* all trades were executable and estimate opportunity costs.

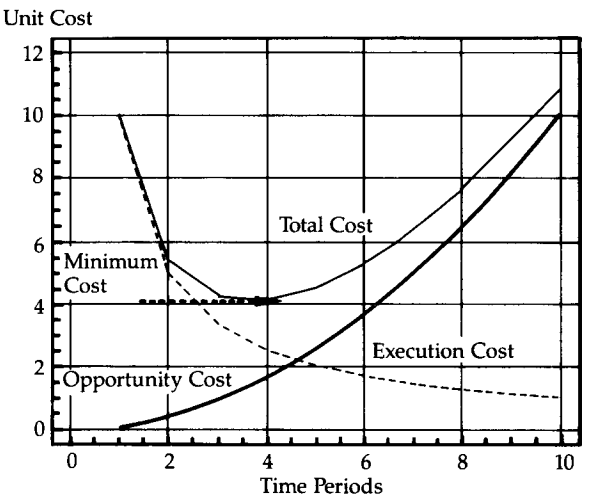
The broadest definition of investment costs is the difference between expected performance and actual performance. The expected performance of a strategy can be represented by an investment benchmark that reflects the desired investment. Investment costs arise when the performance of the benchmark differs significantly from actual investment performance over the measurement period. The difference may be attributable to the cost of trading the strategy, which we refer to as execution costs, or to the inability to execute desired trades, which we refer to as opportunity cost. The performance shortfall, therefore, is a combination of commissions, execution costs and opportunity costs.

Cost Tradeoffs

Any cost management program must consider all three sources of costs, especially since reducing one cost may increase another. The dramatic decline in commission rates, for example, has altered the risk-reward characteristics for upstairs market-makers. The consequence may be an increase in bid/ask spreads and execution costs or in opportunity costs because the search costs associated with finding the other side of the trade have increased.

Reducing market impact may reduce execu-

Figure B Cost Tradeoffs, Execution vs. Opportunity Costs



tion costs. One way to reduce market impact is to delay trading until the price is right. But this may lead to missed investment opportunities, which increase opportunity costs. Figure B illustrates the tradeoff between execution costs and opportunity costs. The vertical axis represents unit costs, where the units could be cents per share, basis points or dollars. The horizontal axis represents time periods, which could be minutes, hours or days. The downward-sloping line represents execution costs and shows that execution costs are positively related to immediacy of execution. The upward-sloping line represents opportunity costs (the costs of delaying execution) and shows that opportunity costs are positively related to delay in execution. The parabola represents total costs and suggests that total costs can be minimized by an appropriate tradeoff between execution costs and opportunity costs.

Figure B represents the general shape of execution and opportunity cost functions; the actual shapes of the curves will differ across management styles. Table II relates a sample of investment management approaches to cost structures. Value managers and growth managers, for example, have longer investment horizons, lower demand for immediate execution and a flatter opportunity cost curve than managers that employ models based on earnings surprise. Consequently, value and growth-oriented managers need not pay high immediacy costs.

As a general rule, if the slope of the opportunity-cost curve is less than the slope of the execution-cost curve, one can afford to wait to find a natural transactor on the other side of the trade. Investment strategies that meet this description can be used to offset the cost of liquidity.

Measuring Transaction Costs

Transaction cost measurement faces three separate problems—(1) calculating the commissions related to a particular asset or trading style, (2) determining a benchmark for measuring execution costs and opportunity costs and (3) separating the influence of the trade from other factors.

Commission rates, taxes and fees for a given transaction are readily observable and fixed. Commissions for different assets vary. The commission rates on a futures contract are under two basis points, while rates for stock are six to 12 basis points. Nonetheless, this component of costs is negotiated on a pretrade basis and is known and measurable.

The measurement of other components of transaction cost, particularly market impact, has no unique solution. In general, however, the market impact cost equals the difference between the execution price and a fair market benchmark:

$$\text{Cost} = \text{Execution Price} - \text{Fair Market Price}.$$

Table II Management Style versus Costs

Management Style	*Trading Motivation*	*Liquidity Demands*	*Execution Cost*	*Opportunity Cost*
Value	Value	Low	Low	Low
Growth	Value	Low	Low	Low
Earnings Surprise	Information	High	High	High
Index Fund Large-Cap.*	Passive	Variable	Variable	High
Index Fund Small-Cap.	Passive	High	High	High

* The costs associated with some investment strategies that utilize futures can be low despite high opportunity costs.

The fair price is the price that would have prevailed had the trade not taken place. Because this price is unobservable, it must be estimated or inferred. This may involve choosing a price that represents the fair value of a security in the trade's absence from the market or a price that represents the consequence of the trade's presence in the market.

We present three different approaches to measuring market impact. We refer to these as (1) pretrade measures, (2) post-trade measures and (3) across-day, or average, measures. Pretrade measures use prices occurring before or at the decision to trade, while post-trade benchmarks use prices after the decision to trade. Average measures use the average, or representative, price of a large number of trades.

Essentially, all three approaches attempt to measure the fair value of an asset at a point in time and define any difference between this value and the actual execution price as a cost. To the extent that any price represents an unbiased estimate of a fair price, these approaches are valid. They do, however, assume that markets are efficient.

Fair Price Benchmarks

Pretrade measures use a price that existed prior to the trade as a fair price benchmark.[7] This may be the previous night's close or the price at which the stock last traded. The premise behind pretrade benchmarks is that the only way of knowing the impact of a trade on the price of the stock is by comparing the trade's execution price with conditions prior to the trade's arrival in the marketplace.

One could compare the execution price with the price at which the stock last traded or, where a time lag exists, to the midpoint of the bid/ask spread. In either case, market conditions before execution represent the reference point for evaluating any price movement induced by the trade. Any positive difference between the execution price and the benchmark is regarded as a cost.

Detractors of the pretrade benchmark argue that it violates a fundamental requirement for a good measure of execution costs—that is, that the measure be independent of the trading decision. In other words, the trader should not be able to "game" the trade.[8]

Use of a post-trade benchmark presumably avoids the problem of gaming, because post-trade prices are independent of the trading decision.[9] In this case, however, one must be careful to select a measurement interval that lies outside the influence of the trade. Choices for post-trade benchmarks include the price of the trade immediately following the closing price on the trade date, or any price subsequent to the time of execution. If the post-trade benchmark indicates a price reversal, market impact cost is positive.

A representative price for the trade date could be calculated as the average of the high and low or the trade-weighted average price.[10] Both measures, however, are subject to gaming. The trade-weighted average price, for example, can be gamed by spreading a trade out across the trading day. By executing a major portion of the desired trade at the open, the close and around large block trades, the trader may be able to lower measured market impact cost by taking advantage of other traders' liquidity demands. This trading style is essentially reactive, rather than proactive, and may not produce the best results.

Proponents of average-price benchmarks argue that they provide better measures of market impact than post-trade benchmarks because they are more representative of an equilibrium price.[11] In reality, they may provide a better indication of the market timing portion of execution costs than the market impact component.

Other adjustments can be made to capture the cost effects of general market or factor movements.[12] For example, multiple buyers may enter the market as part of a strategy to increase market exposure, and their activity may cause prices to change between the time a trader's order is entered and the time it is executed. In this case, the trader can adjust the benchmark to obtain an unbiased estimate of fair price. The resulting execution cost measure captures the residual effect of the trader's transaction. A positive residual indicates a trading cost. The expression below is an example of a cost estimator using this approach:

$$\text{Cost} = \text{Execution Price} - \text{Benchmark} - \text{Sum}\,[\text{constant}(i) \times \text{factor}\,(i)].$$

Table III summarizes the different approaches to measuring execution costs and their advantages and disadvantages.

Table III Cost Measurement Techniques

Method	*Benchmarks*	*Advantages*	*Disadvantages*
Pretrade	Last Sale Previous Close 1/2 Bid/Ask Spread	Captures Current Market	May Affect Trading Decision
Post-Trade	Next Sale Trade-Day Close N-Day Close	Avoids Gaming	Neglects Pretrade Information-Based Moves and Market Effects
Intraday	Avg. High/Low Weighted Avg.	Measures Daily Market Timing	Subject to Gaming
Factor Adjusted	Market/Industry	Captures Residual Effects	Difficult to Measure

Incorporating Opportunity Costs

Many cost measurements focus on the execution component of transaction costs. However, a more complete picture of transaction costs and their impact on investment performance requires a method for measuring the sum of execution costs and opportunity costs.

Some proponents of post-trade execution cost measures argue that pretrade measures should be regarded as measures of opportunity costs. The argument is that the difference between execution price and the price at the time the decision to trade was made represents a lost opportunity. But opportunity cost measures should also incorporate the implicit cost of not being able to implement a desired investment strategy.

We measure opportunity costs by monitoring the performance of a portfolio that represents the investor's desired holdings. The difference between the performance of this portfolio and the performance of the actual portfolio, adjusted for execution costs and commissions, represents the opportunity cost. Execution costs are measured as the difference between the average of the bid/ask spread at the time the decision to trade was made and the average at the time the order was entered.

To summarize, execution costs can be measured as the difference between actual execution price and the fair price of the security at the time of the trade. There are alternative ways to define fair price. Fair price benchmarks that minimize the possibility of gaming and that can help separate the measurement process from the trading strategy are preferable.

A Cost-Management Methodology

The transaction process is the culmination of the much larger investment process.[13] It begins with the decision to trade and ends only after sufficient time has passed to evaluate performance. This may be the end of a quarter or a fiscal year. Table IV maps out the entire transaction process.

A cost-management methodology should capture as much of the transaction process as possible. In order to accomplish this, real-time prices are necessary. Historical prices can also serve as a point of reference. From the data supplied, the investor should be able to choose from among several different approaches to measuring costs.

To see the value of being able to draw on alternative measures of cost, assume a stock last traded at 45, but has not traded in the last five minutes. Meanwhile, market conditions have changed so that the current bid/ask quote is 45-1/2/45-3/4. Under such circumstances, a cost-measurement system must capture the last traded price, the time of the last trade, the current bid/ask and the execution price. If a buy

Table IV Transaction Process

Pretrade Period	Post-Trade Period		
+ <----------	+ ----------	+ ----------	> +
Decision to Trade	Trade Executed	End of Trade Effects	End of Period
Pretrade Benchmark	Execution Price	Post-Trade Benchmark	Terminal Value
<---------- Opportunity Cost (Trades not Executed) ---------- >			

order is executed at 45-3/4, an execution cost measure that uses the last traded price as a benchmark would indicate that the price impact is 3/4, when clearly that is not the case. Alternatively, an average of the current bid/ask indicates a price impact of 1/8th, which is more indicative of actual trading conditions.

Our proposal for a cost-measurement system involves a set of computer-based screens that present real-time data and can be used on a trading desk during the day. Any of the information presented on the screen can be saved for *ex post* analysis. In addition, we propose a set of daily reports that can be made available after the market close.

Portfolio Profit-and-Loss Statement

The first screen monitors the performance of an asset or portfolio and provides a real-time profit-and-loss statement. Table V shows one example.

Here "buy" and "sell" are actual portfolios and "paper" is the desired portfolio. The strike is the value of the portfolio, in millions, based on the benchmark price. The real-time value, in millions, is based on the last sale. P/L represents the change in the value of the position versus the strike, using the bid, ask or last-sale price. The P/L is flexible; it can be set for any time period and expressed in percentage points, index points or dollars. In addition to these data the user can call up the individual assets that make up any portfolio.

In Table V, the portfolio identified as PORT is a long position representing a 750,000-share portfolio. It has increased in value above the strike price by 0.530 per cent [(35.641/35.453) − 1], as measured off the last sale. The portfolio ABC is a paper portfolio representing an investor's ideal holdings; it is updated in real time according to the current midpoint of the bid/ask spread. The paper portfolio is up 514 basis points versus its benchmark. (The benchmark may be the value of the actual portfolio or some reference point at the beginning of a holding period.)

This screen is valuable because it provides the user with an update of how a portfolio has performed over any holding period. The strike price can reflect any desired benchmark. If it is based on the execution price, for example, P/L represents the performance of the portfolio since the time of execution; this is useful for comparing the performance of a paper portfolio with that of an actual portfolio. If the strike value is based on the previous night's close, the P/L is the performance for that day.

Table V Portfolio Monitoring Screen*

Basket Code	Type	Total Shares (000s)	Strike	Real-Time Value	P/L Bid	P/L Last	P/L Ask
PORT	Buy	750	35.453	35.641	0.262	0.530	0.790
XYZ	Sell	2000	80.000	80.500	−0.625	−0.625	−0.312
ABC	Paper	1750	61.250	64.400	4.731	5.140	5.550

* The screen monitors real-time asset performance versus a predefined benchmark. The P/L reflects the performance over a prescribed measurement period (such as intraday) using the bid price, the ask price and the last-trade price versus a strike price.

Table VI Pretrade Analysis Screen[a]

Basket Code	Total Shares	Dollar Value Bid	Dollar Value Last	Dollar Value Ask	Spread Impact[b] Bid	Spread Impact[b] Ask	Executable[c] Bid	Executable[c] Ask
PORT	750	35.546	35.641	35.733	0.125	0.125	75.5	45.0

a. This screen is designed to provide information on a pretrade basis. The information can then be used to estimate the cost of immediate execution or to determine the size of a trade that can be satisfied by current market conditions.
b. Spread in cents per share.
c. Executable (per cent).

Execution Data

The screen presented in Table VI identifies the portfolio, the total number of shares in the portfolio, the dollar value (in millions) based on the last sale, the bid and the ask, the spread impact assuming the portfolio is purchased at the ask or sold at the bid, and the percentage of the portfolio executable at the bid and ask. Portfolio PORT is valued at $35.641 million, based on the last sale. If the portfolio were purchased at the ask, the spread impact versus the last sale would be 0.125. Based on the size currently offered, 45 per cent of the portfolio could be purchased at existing ask prices. (Again, the user also has the ability to view the individual assets that make up the portfolio.)

This screen is valuable because it provides the user with real-time information that can be used to estimate the cost of immediate execution and the percentage of the portfolio that can be executed at the current bid or ask price without incurring additional costs. The information can also be used to ascertain whether, in aggregate, an order imbalance is developing; this may be a factor in deciding whether to trade or not.

Table VII Transaction Cost Analysis Report, Execution Costs*

Account: Investor
Basket Code: ABC Buy
Date: 3-20-90

Summary Report

Value of Executed Portfolio	52,413,050
Value of Benchmark Portfolio	52,225,550
Net	187,500
Number of Shares	1,500,00
Number of Securities	200
Weighted Average Price	
Executed	34.942
Benchmark	34.817
Net	0.125

Liquidity Report

Liquidity Factor	95%
Executable	
Bid	45%
Ask	70%

Transaction Cost Measurement

Commissions		$0.05
	Pretrade	*Post-Trade*
Market Impact		
Last (Next)	0.125	−0.125
Close	0.250	−0.375
Midpoint	0.125	−0.125
Market Timing		
WAP	−0.125	
1/2 High/Low	−0.250	

* This summary report is available in hard copy following the close on trade date. The report is intended to provide an estimate of execution costs by comparing the value of the executed portfolio with a benchmark.

The data on the screen can be saved for *ex post* analysis. For example, although the current size of the market quoted on the bid or the ask is the best indicator of liquidity conditions, it may not always represent the liquidity actually available in the marketplace. The amount of the portfolio that can be executed may be on the low side if some of the inventory available for particular stocks is not reflected in the quoted size of the market. The data monitored by this screen can help identify such securities. Furthermore, an analysis of the data can help the trader segregate stocks into portfolios of securities that exhibit similar liquidity characteristics. Some stocks, for example, may be more suitable for limit orders than for market orders; these stocks can be separated out and traded independently.

A hard copy of the data on this screen, listed by individual assets or any aggregation of the assets, constitutes the first report. This report provides the investor with a record of market conditions just prior to the time of the trade and throughout the execution process. Moreover, it allows the investor to estimate transaction costs using real-time benchmarks such as last sale or the midpoint of the bid/ask spread.

Summary Report

A second report, presented in Table VII, is available from the first day after the initial trade date. It provides the investor with summaries of the transaction process, including execution costs and liquidity conditions.

The summary report provides basic information about the executed portfolio versus a benchmark portfolio. The table shows the value of the investor portfolio to be $52.413 million, as measured by the execution price. This compares with $52.225 million for the benchmark portfolio, which is valued using the midpoint of the bid/ask spread at the time the decision to execute was made. These numbers indicate that the actual portfolio cost the investor $187,500 more than the benchmark.

The number of shares transacted and the number of securities represent those shares and securities that actually traded, and may not represent all securities in the portfolio. The remainder are treated separately and combined later when all executions are completed.

The portfolio's weighted average price is reported together with the net difference from the benchmark. The net difference represents a first look at implicit costs. The implied execution cost is $0.125 a share.

The liquidity report presents a liquidity factor—the percentage of the portfolio that can be executed, based on 20-day median volume. The reported liquidity factor indicates that 95 per cent of the share amounts did not exceed median volume. The "executable" figures refer to the size of the market at the time of a trade; 70 per cent of the portfolio could have been purchased on the ask side of the market at the time of execution.

The transaction-cost section presents two alternative market impact measures—pretrade and post-trade—based on three different prices. The pretrade measure uses last sale prior to execution, the previous night's close and the midpoint of the bid/ask spread at the time of execution. The post-trade measure uses the first sale price after the trade, the close on the trade date and the midpoint of the bid/ask spread

upon completion of the trade. The numbers indicate that the portfolio was purchased 0.125 above the midpoint, which is consistent with the net difference reported in the summary. (Remember, positive pretrade numbers indicate a cost.)

This last section also gives market timing costs, estimated by comparing the volume-weighted execution price with the trade-weighted average price (WAP) or the midpoint of the high and low prices on the trade date. Market prices can be affected by factors external to a particular trade, and this may have a detrimental impact on the trade's cost.

Further inspection of the report reveals that the market was up prior to the time of execution (execution price versus previous night's close is positive). Furthermore, there was buying pressure at the time of the trade, which continued after the execution was completed (execution price versus next-sale price is negative) and through the close of the market (as indicated by the execution price versus the close on the trade date).

The market timing figures indicate that the execution was timely; the negative numbers indicate that the market had risen less at the time of the execution than it did after the execution through to the close. Neither measure necessarily has anything to do with the quality of execution at the time of the trade. (The WAP measure, in particular, is misleading.) The market timing measures do indicate that the timing of the trade on that particular day worked in the trader's favor. The execution cost measures, however, indicate that the investor incurred market impact at the time of the trade.

Table VIII Transaction Cost Analysis Report, Opportunity Costs*

Account: Investor
Basket Code: ABC
Date: 4-20-90

Summary Report		
Value of Paper Portfolio	64,400,000	
Value of Actual Portfolo	63,586,181	
Total Cost	**813,819**	**Per Cent**
Execution Costs	187,500	23.06
Commissions	75,000	9.20
Opportunity Cost	551,319	67.74
		100.00
Number of Shares	1,750,000	
Number of Shares Executed	1,500,000	
	250,000	

* This summary report is available in hard copy following the close on trade date. The report is intended to provide an estimate of opportunity costs by comparing the value of a desired portfolio with an actual portfolio.

Table IX Stock Summary Report*

			Price Impact			Liquidity	
Ticker	*Shares*	*Executed Price*	*Last*	*Bid/Ask*	*Next*	*Bid*	*Ask*
AXP	10,000	34.00	0.125	0.0625	−0.125	100%	65%

* This report provides execution cost estimates for each security in the portfolio.

Total Cost

Table VIII presents the total cost of implementing an investment strategy as the difference between the performance of an investor's desired portfolio and the performance of the actual portfolio. In the sample, the current value of the investor's desired (paper) portfolio is $64.4 million, while the value of the actual holdings is $63,586,181. The difference represents a cost to the investor of $813,819. Opportunity costs add up to $551,319 (67.74 per cent of the total) and are a consequence of not being able to execute 250,000 shares over the investment holding period. The report also indicates that execution costs and commissions were 23.06 and 9.2 per cent of total cost, respectively.

This report separates costs into the three components critical to the design of a trading strategy that minimizes costs and improves performance. As our sample shows, the inability to make desired trades is clearly costly. The investor should be prepared to incur greater execution costs by trading more aggressively. The reduction in opportunity costs should exceed the increase in execution costs and be reflected in performance.

Table IX shows a sample of a stock summary report, which provides some information about the individual issues in a portfolio. Included in this report are the price impacts as measured against the last traded price, the midpoint of the bid/ask spread and the next-trade price. In our example, the investor paid 0.125 above the previous trade, but 0.125 less than the next. These figures are indicative of a rising market. The liquidity information indicates that 100 per cent of the order could have been sold at the bid and 65 per cent purchased at the ask.

This report can identify individual stocks that are difficult or costly to trade. This information

Table X Portfolio Trade Report*

		Last			Bid		Ask		Execution		
Ticker	*Shares*	*Price*	*Share*	*Time*	*Price*	*Share*	*Price*	*Share*	*Price*	*Share*	*Time*
AXP	100	33.875	10	10:53	33.875	150	34	65	34	100	10:54

* This report presents market conditions at the time of execution for each security in the portfolio.

can be used to group stocks into different cost categories, to which different styles of trading can be applied. For some less liquid securities, for example, it might be appropriate to work the orders upstairs rather than include them as part of a market order.

Table X presents a sample portfolio trade report reflecting market conditions at the time of a trade. The table indicates that AXP last traded 1000 shares (shares are presented in round lots) at 10:53 a.m. at a price of 33.875. The bid at the time was 33.875 for 15,000 shares, and the ask was 34 for 6500 shares. An order to buy 10,000 shares has just been executed at the ask side of the market. The time elapsed since the previous trade is one minute. The per-share execution cost, using the midpoint of the bid/ask spread as the benchmark, is 0.0625, or 34 − [(33.875 + 34)/2]. This report can be used to evaluate the quality of execution from the market-maker and to detect any unusual circumstances surrounding a particular trade.

This set of reports provides an investor with information about the entire transaction process. The investor can monitor the price behavior of a security or group of securities at the time of execution and over any subsequent period. By doing so, the investor can better understand the conditions that give rise to transaction costs, evaluate the quality of execution, identify stocks that are difficult to trade and incorporate costs into the investment process.

Benefits to Active and Passive Strategies

The importance of incorporating the management of transaction costs into the overall investment strategy cannot be overemphasized. For actively managed portfolios, a cost-management system facilitates identification of sources of portfolio underperformance. Also, by allowing a manager to compare the performance of desired holdings with that of actual holdings, a cost-management system can lead to improved portfolio returns via an improved tradeoff between execution and opportunity costs. Furthermore, managers that have identified a universe of substitutable securities can use their knowledge of transaction costs to construct better (less costly) active portfolios.

A cost-management system also offers some advantages for passively managed portfolios. Two sources of underperformance for passive funds are cash drag and rebalancing costs. Cash drag basically reflects opportunity costs. Rebalancing costs are incurred when the holdings of a portfolio have to be changed because of new investments, reinvestment of dividends, redemptions or changes in the underlying benchmark. A cost-management system can be used to estimate, record and monitor these costs, and the knowledge derived from this process can be used to structure portfolios that achieve an optimal tradeoff between transaction costs and performance. The impact of transaction costs on the portfolio construction process can be particularly significant for non-S&P 500 portfolios such as Russell 2000 replicating portfolios.[14] ■

Footnotes

1. For a summary of published studies on transaction costs, see L. Birinyi, "Transactions Costs: A Trader's Perspective" (Birinyi Associates, Inc., New York). For an extensive treatment of transaction costs, see W. H. Wagner, ed., *The Complete Guide to Securities Transactions* (New York: John Wiley & Sons, 1989). Also, see S. Bodurtha and T. Quinn, "Does Patient Trading Really Pay?" *Financial Analysts Journal*, May/June 1990.
2. We do not address custodial fees or transfer fees. However, as Ted Aronson has pointed out, these costs may be significant in the context of small dollar portfolios and high turnover management styles.
3. See Cuneo and W. Wagner, "Reducing the Cost of Stock Trading," *Financial Analysts Journal*, November/December 1975 for an exposition of the distinction between these two classes of trades and the implications for reducing costs.
4. This type of figure first appeared in H. Demsetz, "The Cost of Transacting," *Quarterly Journal of Economics*, February 1968.
5. A. F. Perold, "The Implementation Shortfall:

Concluded on page 44.