Securities Trading: Principles and Procedures

Chapter 8: Transaction costs

What does it *cost* to trade?

The long-term investor

- We make a distinction between "investment profits/losses" and "trading profit/losses"
 - The investment process is long term and involves analysis and selection of securities.
 - The trading process is short term.
- Most long term investors:
 - Trade only to implement investment decisions.
 - Are not positioned to pursue trading profits.
 - Don't have access to customers.
 - Don't want to accommodate customers' trading needs.
 - Experience trading as a cost.
- How should these trading costs be measured? Copyright 2015, Joel Hasbrouck, All rights reserved

Why bother?

- \Box Total profit = cash returned cash invested
 - Attributions of "investment profit" and "trading costs" don't affect the total.
- Distinction is important because portfolio and trading decisions are often separated and delegated.
 - Separation (different people, different roles)
 - Portfolio manager vs. trading desk vs. broker
 - Delegation (the people managing the investment and trading processes are agents for the beneficiaries of the investment)
 - Mutual funds: the beneficiaries are the fund shareholders.
 - Pension funds: the beneficiaries are current and retired employees.
 - The investment managers are legally responsible for monitoring trading costs.

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Implementation shortfall

- The basic perspective on transaction cost measurement is the implementation shortfall described by Andre Perold in 1988.
- Perold defined the *Implementation shortfall* as:
 - Return/profits on a paper portfolio Return/profits on actual portfolio
 - "Paper" here means hypothetical, notional, imaginary.
- The paper and actual portfolios have the same composition (hold the same securities) at all times.
- They only differ in that all trades in the paper portfolio are assumed to be made at *benchmark prices* that are hypothetical prices supposed to represent the "value" of a security at a given time.

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Desploit costs Commissions, net of any rebates ETRADE charges about \$10 per retail trade; Scottrade charges about \$7; Interactive Brokers charges about \$1. Transactions taxes Inplicit costs Costs of interacting with the market (e.g., bid-ask or price impact costs), relative to the benchmark prices. Opportunity costs (the penalty associated with not completing intended trades) Delay (failure to accomplish the trade immediately)

As used today ...

- Implementation shortfall is computed for each order originating from the portfolio manager (PM)
- **u** These orders represent the PM's instructions to the fund's traders.
 - For example: "I'd like to buy 200,000 shares of HZO over the next three days."
 - The large original order is called a *parent order*.
 - It is usually broken down into many smaller *child orders*.
 - The child orders are executed over time, possibly using multiple limit orders.
- $\square Implementation Shortfall = \begin{cases} Trade Price Benchmark Price, for a buy order \\ Benchmark Price Trade price, for a sell order \end{cases}$
- □ If there are multiple trades (executions), the *trade price* is the share-weighted average.
- The most common benchmark is the midpoint of the bid and ask prices ("BAM") at the time the PM's original instruction was given.

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Choices for benchmark prices

- □ Pre-trade
 - The NBBO midpoint at the time the trading decision or order submission decision was made.
 - This is the most common choice, also called "BAM" (Bid-Ask Midpoint)
 - The previous day's closing price.
- □ Post-trade
 - The NBBO midpoint five minutes after the trade.
 - The next day's opening price
- Time-weighted average price (TWAP, "Tee Wap") over the day or duration of the order.
- Value-weighted average price (VWAP, "Vee Wap") over the day or duration of the order.
 - This is the second most common choice.

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The effective cost

- \square *p* is the trade price; *m* is the prevailing NBBO midpoint.
- $\square \ Effective \ Cost = \begin{cases} p m, \ \text{for a marketable buy order} \\ m p, \ \text{for a marketable sell order} \end{cases}$
- For a buy order: "How much did I overpay, relative to the NBBO midpoint?"
- The effective cost is simply the implementation shortfall using the NBBO midpoint as a benchmark.





Price impact

□ Price impact = Effective cost - Realized cost

- For a buy, *price impact* = $(p m) (p m_5) = m_5 m$
- For a sell, *price impact* = $m m_5$
- Price impact measures the movement of the quote midpoint (over five minutes) in the direction of the trade.
 - "If we bought, how much did the midpoint rise?"
 - "If we sold, how much did the midpoint fall?"

















□ Recall

- *p* is the trade price; *m* is the prevailing NBBO midpoint ("BAM").
- *Effective Cost* = $\begin{cases} p m, \text{ for a marketable buy order} \\ m p, \text{ for a marketable sell order} \end{cases}$
- If p > m, we assume "buy" (This would make the effective cost positive).
- □ If *p* < *m*, we assume "sell". (This would also make the effective cost positive.)
- If p = m, the direction can't be determined.
 - In this case, neither the effective no realized costs are defined.

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Reasoning	que 55
	offer \$10.52
Trade at \$10.50 is a "sell"	Previous trade \$10.51
	bid \$10.50
	\$10.50
	offer \$10.50
Trade at \$10.50 is a "buy"	Previous trade \$10.49
	bid \$10.48
□ Look at the price chai	nge ("tick") from the last trade to this trade.
	"
On an uptick, guess "I	buy
\Box On a downtick guess	"se]]"
a on a downer, gaess	Self
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More examples								
	_							
Trade price	50	51	52	51	52	53		
		Buy	Buy	Sell	Buy	Buy		
		Uptick	Uptick	Downtick	Uptick	Uptick		
Trade price	50	51	51	50	50	50		
		Buy	Buy	Sell	Sell	Sell		
		Uptick	Zero-uptick	Downtick	Zero- downtick	Zero- downtick		
Trade price	62.10	62.10	62.09	62.15	62.15	62.14		
		۲ ه	sell	buy	bry	sell		

Related technical indicators

- Over a day, the volume (in shares) executed on an uptick (or zero-uptick) is the *uptick volume*.
 - ... on a downtick ... *downtick volume*.
- \Box money flow = uptick volume downtick volume

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Attribution of price impact

- □ For an individual order, the price impact is defined as
 - $\Delta BAM = effective \ cost realized \ cost$
- The actual attribution (connection between the order and the price change) is sensitive to timing.
- □ For example
 - Suppose that each trade individually moves the bid-ask midpoint by \$0.10.
 - We have three trades in quick succession.

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□ The average price impact is

(\$0.10 + \$0.20 + \$0.30)/3 = \$0.20

- There appears to be a larger impact because the trades are very close in time.
- Why are the trades close in time?
 - Trader A thinks, "Other people are watching what I do. They quickly copy my orders."
 - Trader C thinks, "My broker must have leaked this order, because other traders got to the market immediately ahead of me."
 - Another possibility: *A*, *B* and *C* are all using similar strategies and responding to the same news.
- □ If *A*, *B* and *C* actually experimented with submitting orders at random times, they'd typically observe price impacts of \$0.10.







Ignoring opportunity costs for limit orders: the problem

- □ Suppose that the average spread in a stock is \$0.10.
 - The half-spread is \$0.05
- A hedge fund decides to try an experiment to measure order costs.
 - Submit 100 buy market orders.
 - Submit 100 buy limit orders priced at the bid.
- Compare average effective costs for each strategy.

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Outcome

- All of the market orders will execute, paying (on average)
 \$0.05 above the midpoint.
 - Average effective cost = \$0.05
- Some of the limit orders will execute. Those that *do* execute pay (on average) \$0.05 *below* the midpoint.
 - Average effective cost = -\$0.05
- Conclusion: "we should use more limit orders."

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Complication

- Limit buy orders don't execute because the market price has moved up, and the limit order is left behind.
 - We don't buy stocks that subsequently go up in value.
 - This is costly: there is an opportunity cost for the failed executions.
- One approach to estimating the opportunity cost.
 - Assume that unexecuted limit orders are replaced at the end of the day by market orders.
 - We impute a fill at the closing price.
- The Tokyo Stock Exchange has a Funari order (a limit order that at the end of the day becomes a market on close order to any unexecuted portion).

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Analysis of buy limit order priced at 9.99

- If it executes we pay 9.99; if it doesn't, we'll have to use a final market order to complete the purchase.
- On 5 of the 8 paths, the order executes (we pay 9.99)
- On the remaining 3 paths, the order doesn't execute and we have to pay the end of day offer price.
 - On 2 paths we pay 10.01
 - On 1 path we pay 10.03
- On average, we pay $\frac{5}{8} \times 9.99 + \frac{2}{8} \times 10.01 + \frac{1}{8} \times 10.03$ = 6.24375 + 2.2025 + 1.25375 = 10.00
- □ This is the same as if we'd initially used a market order.

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Summary

- □ If we assess limit orders using a pre-trade benchmark ...
 - and only look at executions,
 - then limit orders seem to have great performance.
- With penalties for execution failures, limit orders DON'T look so great.
- In a random-walk model where we must execute at some point, limit orders are equivalent to market orders.
- □ This equivalence is not robust.
 - Minor changes in the setup can make limit orders a bit better or worse.

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Delay

- When a large order is being worked over time, the price generally moves away from the order, even ignoring the price impact of the executions.
 - This increases the trading cost.
 - If we could have done the full trade immediately, we'd have avoided this cost.
- □ Example
 - 10,000 sh to buy. Split as 2,000 per hour over next five hours.
 - Over the five hours, the price tends to rise.
- **By** some estimates, the cost of delay is very high.



SEC Rule 605.

- A market center (any exchange or broker who executes orders) must report execution statistics.
 - These statistics must be reported on the market center's website.
- Compliance is usually minimal: the data are simply dumped in raw form.
- □ Interactive Brokers reports in an easy-to-understand layout.
 - interactivebrokers.com → About IB → Performance Reports → ... Monthly Rule 605 ... Reports
 - Next: stats for ticker symbol A (Agilent Technologies, November, 2013)

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	Mrkt	100- 499	38	8326	0	8326	0
	Mrkt	500-1999	14	9884	0	9884	0
	mktL	100- 499	49	10262	0	10262	0
	mktL	500-1999	9	8050	0	8050	0
	mktL	2000-4999	1	2000	0	2000	0
А	Mrkt.	100- 499	281	48661	0	48661	0

- prior to execution.
- McExecShr Market Center Executed Shares: Cumulative number of Shares of Covered Orders executed.
- AwyExShr Away Executed Shares: Cumulative number of Shares of Covered Orders routed to another market by Interactive Brokers Ats and then executed.

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Type	<u>Size</u>	<u>Orders</u>	Shares	ARS	AES	ImprShr	ImprAmnt
Mrkt	100- 499	38	8326	-0.0514	0.0154	3277	0.0100
Mrkt	500-1999	14	9884	-0.0384	0.0118	1000	
mktL	100- 499	49	10262	0.0438	0.0123	2358	0.0100
mktL	500-1999	9	8050	0.0941	0.0084	1300	
mktL	2000-4999	1	2000	-0.9300	0.0300	2000	0.0100

- ARS is the Average Realized Spread (= $2 \times average \ realized \ cost$)
- AES is Average Effective Spread (= $2 \times average \ effective \ cost$)
- ImpShr is Price Improved Shares: The cumulative number of shares of covered orders executed with price improvement
- ImpAmnt is (for the shares that had price improvement) the average price improvement (\$/sh)

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Analysis of market orders, 100-499 shares

- □ *Avg price improvement* = $\frac{3,277}{8,326} \times$ \$0.01 = \$0.0039
- □ Avg effective cost = $\frac{\$0.0154}{2} = \0.0077
- □ Recall:
 - Price improvement + effective cost = $\frac{1}{2} \times bid/ask$ spread
 - Implied spread = $2 \times (\$0.0039 + \$0.0077) = \$0.0232$
- □ Avg realized cost = $-\frac{\$0.0514}{2} = -\0.0257
- Avg price impact = effective cost realized cost = \$0.0077 + \$0.0257 = \$0.0334

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TAQ Exercise: Part II, Transaction cost analysis (TCA),

- Due date: Tuesday, March 24.
- □ In this part of the exercise, you'll compute transactions costs for a few trades in your stock.
- □ For the first two trades after 15:45:00.00, determine the trade direction by comparing the trade price to the NBBO midpoint (BAM). For these two trades, perform a TCA. Your report should include, for each trade: the times and NBBOs prevailing at the time of the trade, and five minutes after the trade; the price improvement, effective cost, price improvement and price impact. Note: if a trade has an indeterminate sign (because the trade price is equal to the BAM), go forward until you find a trade that can be signed.
- Retrieve the Rule 605 data for your stock from Interactive Brokers for December, 2014. (Go to <u>interactivebrokers.com</u>, then "About IB"; "IB Regulatory Reports and Financial Information"; "Interactive Brokers Rule 605 Monthly Market Center Execution Quality Reports".) You will probably find it easiest to work with the December HTML file, because it is formatted nicely. For the size category that has the largest number of trades (and this might be a small number), determine the average realized and effective spreads, and the average price improvement. NOTE: ticker symbol AOR is not traded at IB. If your symbol is "AOR", use symbol "ASA" instead.

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