Transaction Costs

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Abstract
In his seminal paper *The Nature of the Firm*, Ronald Coase (1937) introduced the concept of transaction costs as the unavoidable cost of doing business. In the context of a trading strategy, the cost it takes to establish or implement a trading decision made by the strategy is referred to as the transaction cost. Transaction costs are ultimately passed on to the investor, eroding returns. It is a common misconception that transaction costs are inconsequential and transparent. Indeed, they can be similar in magnitude to, or even greater than, management fees and are costs investors bear regardless of performance. Further, transaction costs assume greater importance in a low-return environment as they effectively represent a "hurdle" which must be cleared each year before profits are realized.

Keywords
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1. An Introduction to Transaction Costs

In the context of a trading strategy such as systematic trend following, the cost it takes to establish or implement a trading decision is referred to as the *transaction cost*. These costs have the potential to significantly impact net returns and fund performance. Transaction costs can be separated into two main categories: *explicit* and *implicit*. Explicit costs are readily identifiable, typically known in advance of trading, and include commissions, fees, and taxes. Explicit costs often receive the most scrutiny but are typically (or at least, should be) a relatively small fraction of total transaction costs an investor incurs.

Implicit costs are less directly observable but can far outweigh explicit costs. The most basic component to implicit costs is the bid-ask spread (the difference between the bid and the ask price, explored further in Section 3), but other factors such as the size of a transaction, the timing of execution, and movement of an asset price over the course of trading also contribute. For example, delay costs can arise from movement in the market price after a trading decision is made, but before execution commences. Transaction costs can also be the result of market impact (the impact a market participant's own trading has on the price) or price drift (the movement of the market price resulting from the activity of other market participants). An archetypal trading strategy may also incur financing fees, costs associated with hedging foreign exchange and interest rate risks, and costs ensuing from the need to roll positions forward.

An exhaustive review of the subject is beyond the scope of this brief report, so we have chosen to focus on three key areas of trading strategy design that influence transaction costs:

- Turnover: amount of trading activity
- Liquidity: availability of the instruments transacted
- Execution Strategy: implementation approach employed during trading execution

2. Turnover

When used in the context of a trading strategy, *turnover* refers to the volume of trading activity. Turnover can be a product of trading frequency or of trading style. For example, faster trading strategies that have short holding periods trade more frequently than slower strategies, resulting in higher turnover and thus tend to be impacted more by transaction costs. In the case of systematic trend following, the speed of the strategy is often determined by a "look-back" window (usually measured in weeks or months) which controls the way the strategy responds to new data and functions as a proxy for trading speed. The shorter the window, the faster the strategy reacts to new information and vice versa. Higher trading speeds lead to higher turnover (we make an effort to quantify this in Section 3). Given the potential for diversification benefit, investment managers sometimes employ a range of trading speeds.

Independent of trading frequency, the style of trading pursued by a strategy can also have an influence on turnover. For example, relative value trading, which typically needs to execute at least four transactions to establish and exit a single position, and often involves the use of significant leverage (and thus higher costs) can experience greater turnover than a comparable directional trading strategy.

Additionally, a trading strategy that makes several large trades may incur greater transaction costs than a strategy that makes a larger number of smaller trades, even though the turnover is equivalent. Several studies (e.g., Gatheral (2010); Torre (1997); Almgren et al. (2005); Jones (2002)) have shown that market impact increases proportionally with the square root or power 3/5 of the executed size (customarily expressed as a proportion of the available liquidity, which will be discussed further in Section 4). This implies that transaction costs can increase non-linearly with the size of a trade.

3. Market Liquidity

Systematic managers often trade futures markets since they offer a wide array of investment opportunities, including equities, bonds, rates, commodities and foreign exchange. The liquidity characteristics (volume traded, spreads, open interest, daily volatility, etc.) of these markets vary significantly from one another. It is common for managers to trade a large number of markets in an effort to build a diverse portfolio with strong risk-adjusted returns. However increasing the number of assets traded by a strategy also requires the trading of markets with less liquidity, which can increase transaction costs.

Bid-Ask Spread

The difference between what a buyer will pay and what the seller will receive for a particular asset at a given point in time is referred to as the *bid-ask spread*. The bid-ask spread is often used as a proxy for transaction costs (Demsetz, 1968; Glosten and Harris, 1988) since it is relatively easily quantified and is an accurate reflection of the instantaneous cost of executing a trade. In Figure 1, we compare the bid-ask spread vs. liquidity for 120 futures markets (ranked from highest liquidity to lowest liquidity). We see that in general, as liquidity decreases, the bid-ask spread increases, which has been demonstrated previously (e.g., Tinic and West (1972); Jones (2002)). One explanation which might explain such a relationship is that as more trading takes place, tighter bid-ask spreads are needed for market making to be profitable.

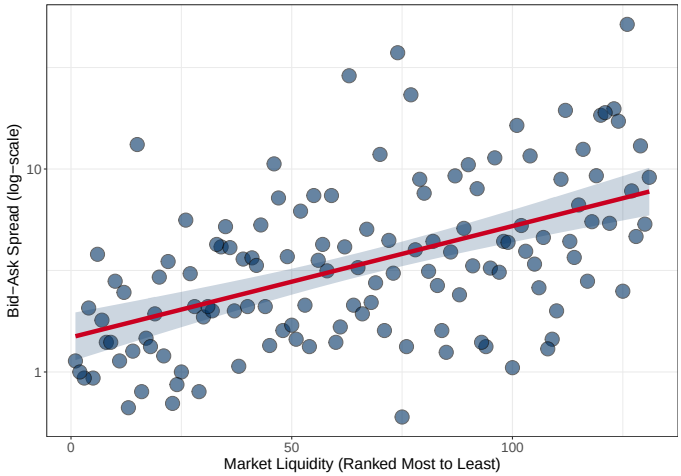

Figure 1. Markets are ranked by their liquidity (most liquid to least liquid) and to examine the bid-ask spread. The spread serves as a useful proxy for transaction costs and increases as liquidity decreases. Note the log scale on the y-axis, so the spread for the least liquid asset is 10x that of the most liquid.

Impact of Liquidity on a Trading System

We performed a simple simulation to assess the impact of transaction costs on a systematic trend following strategy using the SG Trend Indicator[1]. To calculate the impact of transaction costs as we increase the size of the market universe, we begin with the 10 most liquid assets and progressively include additional markets in order of liquidity (most liquid to least liquid). For transaction costs, we assume a value proportional to the bid-ask spread.

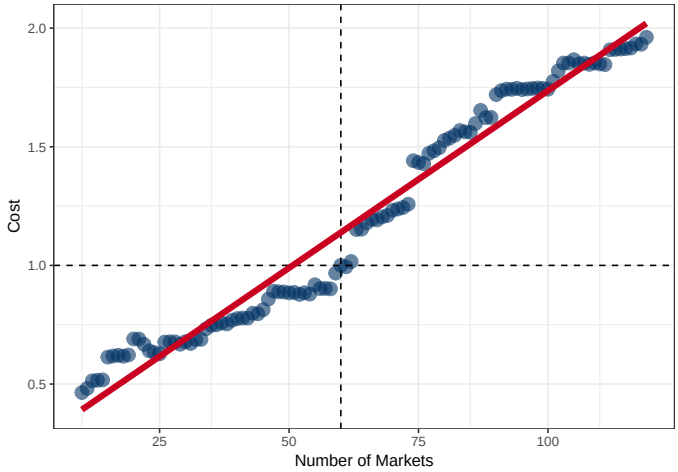

Figure 2. Transaction costs scale with remarkable stability as the number of traded markets increases. For example, trading 120 markets costs nearly twice as much as trading 60 markets. Here the chart has been normalized to 60 markets.

We see a clear positive relationship between a larger market universe and higher overall transaction costs (Figure 2). The most notable aspect is the monotonic stability with which transaction costs increase as the market universe expands. For example, doubling the number of traded markets nearly doubles the transaction costs for the same level of risk. Moreover, we have previously reported (see GCM Research Note on Market Diversification) that increasing the number of markets in a traded universe seems to hit a performance ceiling between 40 to 50 markets, such that adding additional markets does not necessarily produce additional performance. Taken together, there seems to be limited additional benefit of including a large number of markets (particularly those which are less liquid), as transaction costs increase with minimal increase to performance.

The Impact of Turnover Revisited

As discussed in Section 2, a systematic trend following strategy's turnover tends to decrease as the look-back window increases. The SG Trend Indicator uses a base (20,120) moving average crossover, with a trading signal generated when a short-term average (**20**,120) crosses through a long-term average (20,**120**). Using the SG Trend Indicator, we can simulate the impact of trading frequency on transaction costs. In theory, a "slow" system, with a long look-back window, can be expected to realize lower costs than a faster system since there is less turnover, whereas a faster system will turn over more frequently, thus increasing cost; indeed our results indicate that this is the case. In Figure 3, one can see that a faster version of the SG Trend Indicator (speeds increase along the y-axis) can realize transaction costs 4-5x that of a slower version (e.g., the costs associated with 50 markets at a speed of (5,30) are 4.5x those trading 50 markets at a speed of (55,330)). We have also demonstrated the non-linear interaction

[1]The SG Trend Indicator is a market-based performance indicator designed to have a high and stable correlation to the returns of trend following CTA strategies. At its core, it uses a (20,120) moving average trading signal. For more details see `https://cib.societegenerale.com/fileadmin/indices_feeds/SG_Trend_Indicator_Methodology_Summary.pdf`

between turnover or speed (y-axis) and market universe size (x-axis), such that a faster strategy which trades a large number of illiquid markets (e.g., a speed of (5,30) trading 110 markets) experiences transaction costs 18x that of a slow strategy that only trades the most liquid markets (e.g., a speed of (55,330) trading 10 markets). These simulations highlight the importance of strategy turnover and market liquidity on transaction costs.

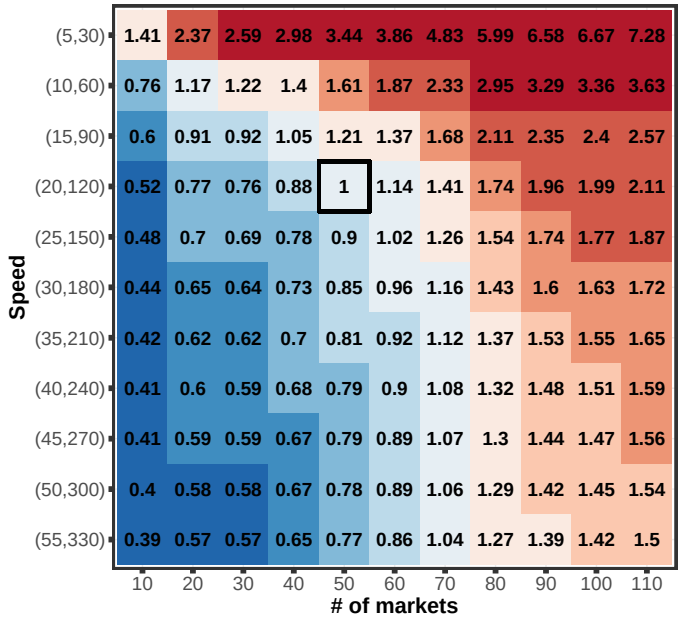

Figure 3. Change in costs across SG Trend Indicator speeds and market universe size. Results are normalized to a (20,120) strategy speed (y-axis) trading 50 markets (x-axis), which we find to be most representative of general trend following. As an example, a faster (5,30) strategy on 100 markets incurs costs around 7x the benchmark (20,120) on 50 markets.

4. Execution Strategy

As discussed in the previous two sections the amount of turnover and the markets traded are two key drivers of transaction costs, therefore a well-designed strategy should take both into consideration. Once a decision to establish or modify a position is made, the trade needs to be executed. When choosing an execution strategy, there is typically a trade-off between *market impact* and *timing risk*.

Market impact refers to the extent to which a market participant can move the price of an asset while buying or selling. The cost has the potential to be much greater in less liquid markets, and during thinly traded time periods (e.g., trading on the Hang Seng is virtually nonexistent during overnight hours). In general, market impact increases as the participation rate (proportion of liquidity removed by a market participant's execution) increases, implying that making a large trade in a short period of time will result in large market impact, adversely moving market price and increasing trading costs. For example, if it is deemed important to execute quickly, one approach is to "sweep" the order, which executes the full order instantaneously at the best available current price. In this case, the order fill happens quickly, minimizing the opportunity for adverse price drift, but often comes at a cost. At a minimum, the transaction is immediately out of the money by half the amount of the bid-ask spread and the total cost may increase further if the order that is placed cannot be satisfied with the current volume that is associated with the current bid/ask price quoted. Additionally, as discussed in Section 2, large trades can exhibit disproportionate market impact.

In an effort to reduce market impact, one approach is to slow down trading, thus decreasing the participation rate. However, this increases the time over which the order is in the market and exposes the execution strategy to potentially adverse moves, known as timing risk (for a more exhaustive review see Almgren and Chriss (2001)). For example, instead of taking liquidity immediately from the market, resulting in market impact as described above, an alternative strategy is to post the entire order at a preferred price (for example via a "limit order") and wait. This option offers the potential to save market impact transaction costs, however, it also runs the risk that the price may move away from the preferred price and will need to be executed at a much less advantageous price (and therefore higher cost) later on. Similarly, delaying the onset of the order for execution also poses a risk that the price may move away from the desired point and is known as a delay cost. Both timing risk and delay costs can be exacerbated in markets or periods with high volatility as it can increase the likelihood of seeing large market moves during the trade execution.

These oversimplified examples illustrate the importance of balancing the trade-off between market impact and timing risk in an effective execution strategy. In practice, investment managers must weigh these trade-offs in combination with the alpha of their investment strategy to formulate an optimal execution strategy and minimize realized costs.

5. Conclusion

In this brief review, we have covered some of the most salient points influencing transaction costs, including turnover, liquidity, and execution strategy. While explicit transaction costs are largely the focus of most investors and receive the most scrutiny, the implicit costs are those which will have the greatest impact on net returns and performance. We used the SG Trend Indicator to simulate the effects of market liquidity on the bid-ask spread and how such an interaction can greatly increase transaction costs. Moreover, the turnover of the systematic trend following strategy can cause transaction costs to increase exponentially as both the speed of the strategy and the number of markets (particularly illiquid markets) increase. It seems as though these variables are interrelated and have the potential to greatly increase transaction costs if they are not balanced properly, suggesting that execution strategies are one of the most important components of trading.

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