

# TCA metric #2

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## **TCA and *fair* execution. The metrics that the FX industry must use.**

An analysis and comparison of common FX execution quality metrics between 'last look' vs firm liquidity *and* its financial consequences.

*speed > price > transparency*

**LMAX**<sup>™</sup>  
E X C H A N G E

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## Part I (ii): Applying standard metrics to a sample data set

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### **(ii) Price variation - slippage and price improvement**

Price variation is a trader's view of the difference between a desired or expected price and the actual execution price achieved by an order. While attention is often focused on slippage (i.e. execution at a worse than expected price) when using market orders we should expect to experience both slippage and improvement. Traders using price constrained orders (limit or PQ) may have been conditioned to expect neither; limit orders cannot slip and many traders do not even consider measuring price improvement.

Measurement of slippage or improvement requires information which may only be available in the trader's own logs. We cannot rely on orders to carry the price which prompted the decision to trade – market orders do not carry a price at all and the price on a limit order is not necessarily the same value as the decision price – making this metric potentially both opaque and highly subjective. However, the order placement behaviour of the TPA is far more predictable, allowing us to measure the impact of price variation consistently and objectively across LPs.

When the TPA receives a customer order, it waits until the market data it receives from the LPs indicates that the order can be filled, meeting all price or size criteria specified. Once suitable market conditions are identified the TPA selects one or more LPs, captures the current best price on the relevant side of the market and sends some or all of the order to the selected LPs for execution as a 'leg'. We have calculated slippage or price improvement per leg by looking at the difference between the logged market price at the time the decision to trade was made and the actual fill price received. This approach removes much of the individual variation from the data, treating the TPA as a single customer trading with each of the LPs and requesting the current price available for immediate execution.

We have excluded numbers from infrequently traded currency pairs (any instrument with less than 100,000 trades over the 12 month period of the data set). The remaining sample set consists of trades in EURUSD, GBPUSD, USDJPY, AUDUSD, GBPJPY, USDCAD, EURJPY, EURGBP, NZDUSD, USDCHF, EURCHF, EURAUD, AUDJPY and AUDCAD, which together represent 91% of all successful trades.

We have reported slippage and improvement using the FX conventions of 'pips', i.e. the 4th decimal place of the price other than for currency pairs priced in JPY where the 2nd decimal place is used. This introduces some comparability issues across currency pairs and over time, for example 1 pip GBPUSD is a smaller proportional slippage than 1 pip AUDUSD, and a 1st January GBPUSD pip is a smaller proportional slippage than a 1st November GBPUSD pip due to the depreciation of GBP over the year. However as all pip values fall within a range close to 0.01% of traded price (between 0.006% and 0.016% at the extremes) we have erred on the side of using familiar units over something abstract but more mathematically accurate such as basis points.

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### Market orders

Table 6 shows the proportion of market orders receiving fills where prices showed slippage, were as expected or showed improvement.

Venue	Slippage	As expected	Improvement	Ratio of slippage to improvement
Bank 3	0.00%	100.00%	0.00%	0
Non Bank 2	1.14%	98.18%	0.68%	1.68
Non Bank 1	19.40%	70.04%	10.56%	1.84
LMAX Exchange	4.36%	93.54%	2.10%	2.08
Non Bank 3	0.64%	99.15%	0.21%	3.05
Bank 2	3.47%	95.65%	0.88%	3.94
Bank 1	7.16%	92.15%	0.69%	10.38

**Table 6: TPA market order price variation statistics**

Chart 1 shows the percentage of orders that experienced slippage or improvement at 0.1 pip intervals. Negative numbers indicate slippage (a worse price than expected) while positive numbers indicate price improvement (a better price than expected).

In addition to the skew and shape of the distribution, it is important to note the scale is limited to +/- 5 pips for illustrative purposes. In many cases the maximum improvement observed is less than 5 pips (denoted by the green marker) whereas the maximum slippage observed is in most cases more than 5 pips away from the zero point (indicated by the red marker). In the TPA data, only LMAX Exchange exceeds 5 pips of price improvement.

The price variation of market orders falls into two distinct categories. There are those venues which show both slippage and improvement at an approximately 2:1 ratio and those for which the slippage is dominant with little or no price improvement.

As LMAX Exchange operates a firm central limit order book offering best execution in price-time priority, we might expect a more neutral result. The skew towards slippage suggests that behaviour in this data set is linked to market direction, demonstrating a propensity towards buying in a rising market and selling in a falling market. This leads to a natural bias towards slippage and away from improvement. If we take LMAX Exchange behaviour as an approximation of the pure market, then this ratio becomes an interesting metric for market order price variation. This allows us to distinguish between those venues which are passing the underlying market price behaviour straight through to the customer against those which show a higher bias towards slippage.

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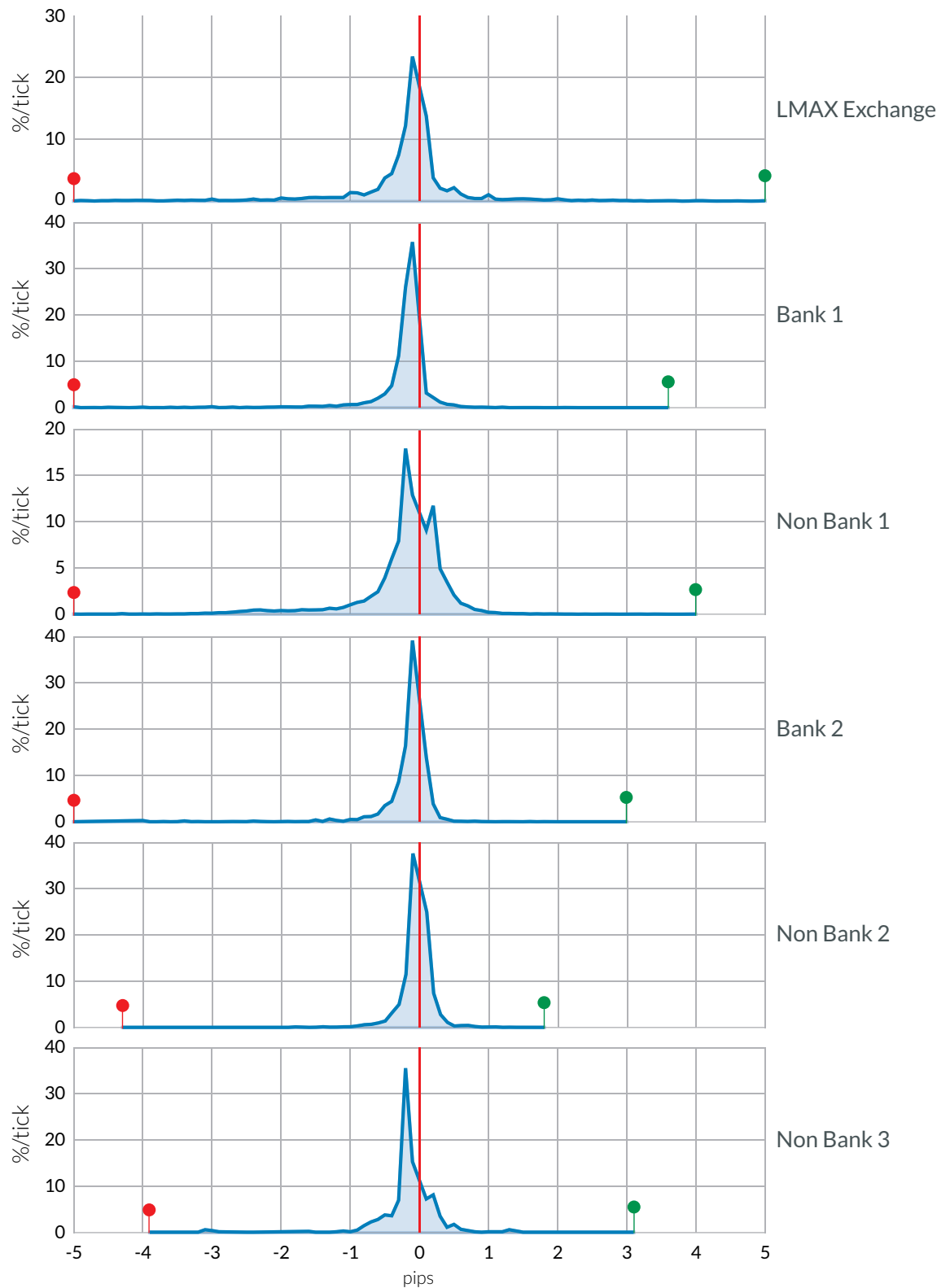


Chart 1: Market order slippage by venue

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### Limit/PQ orders

The situation for order types with price constraints is more interesting. These order types prohibit slippage, and the TPA sets its limit price to the same value it uses as a reference level to calculate slippage or improvement for market orders, so naively we might expect that the price variation for such orders would have a similar incidence and distribution to the price improvement side of the market order charts shown above.

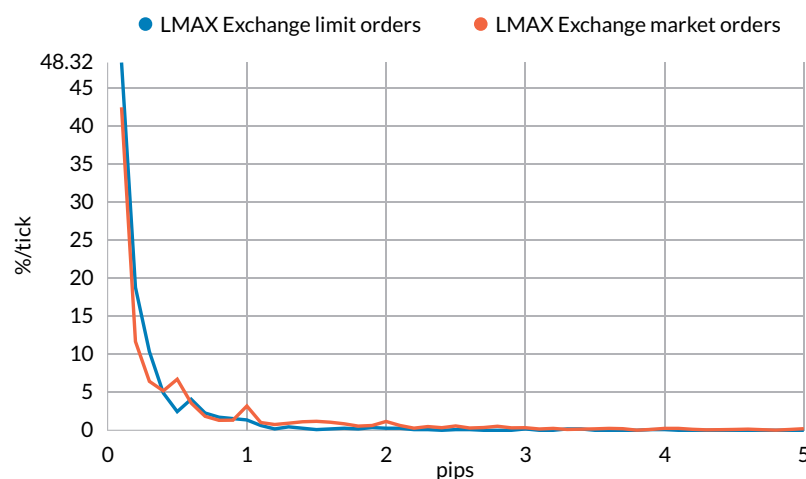
With the exception of LMAX Exchange, this is not the case. Table 7 shows the proportion of limit or PQ orders receiving price improvement by venue, alongside the market order price improvement from the same venue for comparison.

Venue	Order type	Improvement	Market order improvement
LMAX Exchange	Limit	6.358%	2.10%
Bank 1	PQ	0.001%	0.69%
Non Bank 2	PQ	0.000%	0.68%
Non Bank 3	Limit	0.000%	0.21%
Non Bank 1	Limit	0.000%	10.56%
Bank 2	PQ	0.000%	0.88%
Bank 3	Limit	0.000%	0.00%

*Table 7: TPA limit/PQ order price improvement statistics*

Only LMAX Exchange exhibits a significant level of price improvement for limit orders. Improvement is either negligible or entirely absent for limit orders executed on all other venues.

As a further illustration of the mechanism driving limit order price improvement, chart 2 shows the distribution of the level of improvement received by both limit and market orders on LMAX Exchange, showing the percentage of orders that received improvement at 0.1 pip intervals.



*Chart 2: Price improvement for LMAX Exchange market and limit orders*

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The consistent distribution of price improvement observed for both order types is a key characteristic of firm liquidity. Limit prices only constrain the worst execution price for an order. When better prices are available, limit and market orders behave identically.

In contrast, the very different price improvement behaviour observed for market and limit orders on last look liquidity demonstrates a fundamentally different approach to filling limit orders in which LPs exercise their option to fill almost every order at its limit price, even though the evidence of fills on market orders indicates that a better price should be available for some proportion of the time.

For full disclosure, it is worth noting that liquidity providers other than LMAX Exchange offer price improvement. Unfortunately the TPA did not route a sufficient number of orders with any such provider for us to be able to make statistically valid comparisons. As noted above, we would welcome collaboration under NDA with traders with trade databases that include LMAX Exchange, ECNs, Bank and Non Bank venues to further our understanding of execution quality. Returning to the data at hand, the obvious question to ask is where has the price improvement on limit orders gone for all other venues?

### (ii) Section summary: limit/PQ orders

The only venue that offers the same improvement on both limit orders and market orders is LMAX Exchange. This arises from the use of firm execution against a central limit order book, and is driven by exactly the same market behaviour that gives rise to both slippage and price improvement in market orders. None of the other venues provide significant limit order price improvement, even though a subset of them clearly expose similar underlying price volatility on market orders.

#### Metrics scorecard

- **Market order slippage rate.** Looking purely at slippage percentages, LMAX Exchange is in the middle of the table while each of the Bank and Non Bank venues have members in the top, medium and low thirds of the table. As a result we will award all the benefit of the doubt with a medium place.
- **Limit price improvement.** LMAX Exchange is the only venue to offer significant price improvement in this data set.

Metric	Bank 'last look'	Non Bank 'last look'	LMAX Exchange
Market order fill ratio	2	2	2
Limit order fill ratio	1	1	3

Table 8: Price variation score card points (higher is better)

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### Box 3

#### Price variation analysis

Only firm liquidity venues offer consistent price improvement on both market and limit orders:

- The analysis of market orders across the LPs shows that price variation can be either symmetrical (both price slippage or price improvement are passed to the customer without restriction) or asymmetrical (where the price improvement passed to the customer is limited but price slippage isn't);
- Only LMAX Exchange demonstrates symmetrical price variation on both market and limit orders.

The observed price improvement behaviour on last look liquidity demonstrates a fundamentally different approach to filling limit orders in which LPs exercise their option to fill almost every order at its limit price, even though the evidence of fills on market orders indicates that a better price should be available for some proportion of the time.

The obvious question that comes out from this analysis is '**where has the price improvement on limit orders gone for all other venues**'?

## Contact

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