



**AGGREGATION AND LIQUIDITY
MANAGEMENT IN THE
FX MARKET**

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T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G U T Y Z E S D C O R N Q K E X
B Y N D E Q S U Y X **[PREFACE]** P H R Z E J X B Y D
F H B M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F R O V

Analytics are essential in order for clients to fully understand the quality of liquidity they are receiving. Curation based on that analysis forms the basis for liquidity optimisation, with the explicit aim of reducing execution costs in the long run.

The purpose of this paper is to highlight the core metrics and approach that we believe should form the foundation of a client's analytics suite, provide context of what constitutes 'good' and suggest actions from a liquidity curation perspective that deliver optimal results.

XTX Markets is the largest liquidity provider globally in FX spot/forwards (Euromoney, 2019) and an early signatory to the FX Global Code that believes in transparency for financial markets.

We would like to thank Tradefedr for providing examples to support this paper, as well as CMC Markets and Standard Bank South Africa for their participation.

Please refer to the definitions page at the end of this document for clarification of any terms used.

If you have any questions regarding this paper, or would like to discuss it further, please contact distribution@xtxmarkets.com

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G U T Y Z E S D C O R N Q K E X
B Y N D E Q S U Y **[OVERVIEW]** H R Z E J X B Y D
F H B M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F R O V

This paper is intended to help you to address the below questions.

■ How do I measure the quality of liquidity?

■ How can I get tighter spreads?

■ What type of LP should I trade with?

■ What is the optimal number of LPs?

■ Should I trade Sweep or Full Amount?

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G U T Y Z E S D C O R N Q K E X
B Y N D E Q S U Y X **[PROCESS]** P H R Z E J X B Y D
F H B M **Three stages to optimising a liquidity pool** K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F R O V

1. Measuring Liquidity

Analytics are the foundation of identifying high quality liquidity and it is very challenging to improve what you are not measuring.

2. Curating Liquidity Pools

Grouping liquidity providers who exhibit similar behaviour is pivotal to maintaining high quality liquidity. For example, a pool of low market impact LPs.

3. Optimizing Execution

Routing flow to appropriate liquidity sources allows for bespoke pricing, rather than a “one-size fits all” approach that may be worse on aggregate.

T	S	Y	Z	E	S	D	C	O	R	Y	L
G	M	E	A	S	U	R	I	N	G	S	K
A	H	L	I	Q	U	I	D	I	T	Y	V
Q	E	O	H	F	X	K	S	B	F	N	C
S	R	L	B	J	D	Q	Y	G	K	P	M

The foundation of high quality pricing

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[CORE METRICS]** R Z E J X B Y D
 F H B M Y D A B **What to measure** P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

The most relevant of these will vary depending on the participant. However, the core principles remain consistent:

Metric	Description
1. Spread	Visible: The difference between the bid and offer prices. Effective: Measured as: Spread Paid on Fill + (Reject Ratio * Reject Cost).
2. Fill Ratio (%)	Measures the % of attempted trade requests that are accepted. (Accepted volume / Attempted volume) * 100
3. Cost of Rejects (\$)	Measures the immediate mid-price move following a rejection and its associated cost in \$ terms.
4. Last Look Hold Time (ms)	Length of time that an LP holds a trade request before accepting or rejecting measured in milliseconds.
5. Market Impact (\$p/m)	Measures the mid-price movement following a trade, typically measured in minutes.

Table: Created by XTX Markets.

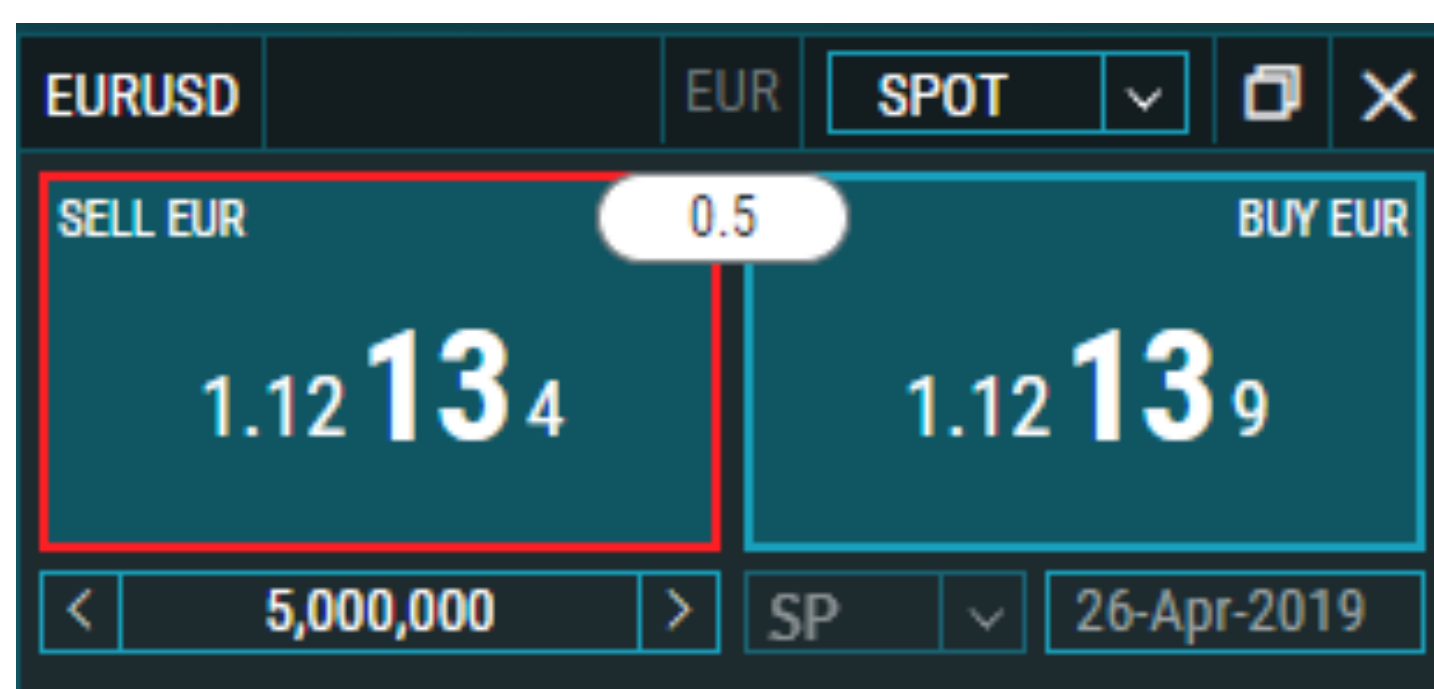
T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S **[CORE METRICS: SPREAD]** Z E J X B Y D
 F H B M Y D A B **Visible & Effective** P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

Effective spread is measured as: Spread Paid on Fill + (Reject Ratio * Reject Cost)

- Spread is a critical measure of an LPs liquidity. However, measuring visible spread alone does not provide the full picture.
- With the presence of last look, liquidity providers have the ability to reject trades meaning you may not get the price that is advertised. The difference between advertised and achieved price is often referred to as slippage. E.g. trade attempt to buy at 50.1, rejected and re-tries at 50.3. The slippage here would be 0.2.
- It is paramount for consumers to measure **visible** and **effective** spread when evaluating liquidity providers. Consistent differences between the two should be investigated and questioned.
- Example: An LP with an average visible spread of 0.7 but a fill ratio of 85% with high cost of rejects may end up with an effective spread of 1.1, which could compare unfavourably to an LP who quotes 0.8 and has a fill ratio of 99% – despite the visible spread being tighter.

Potential Action

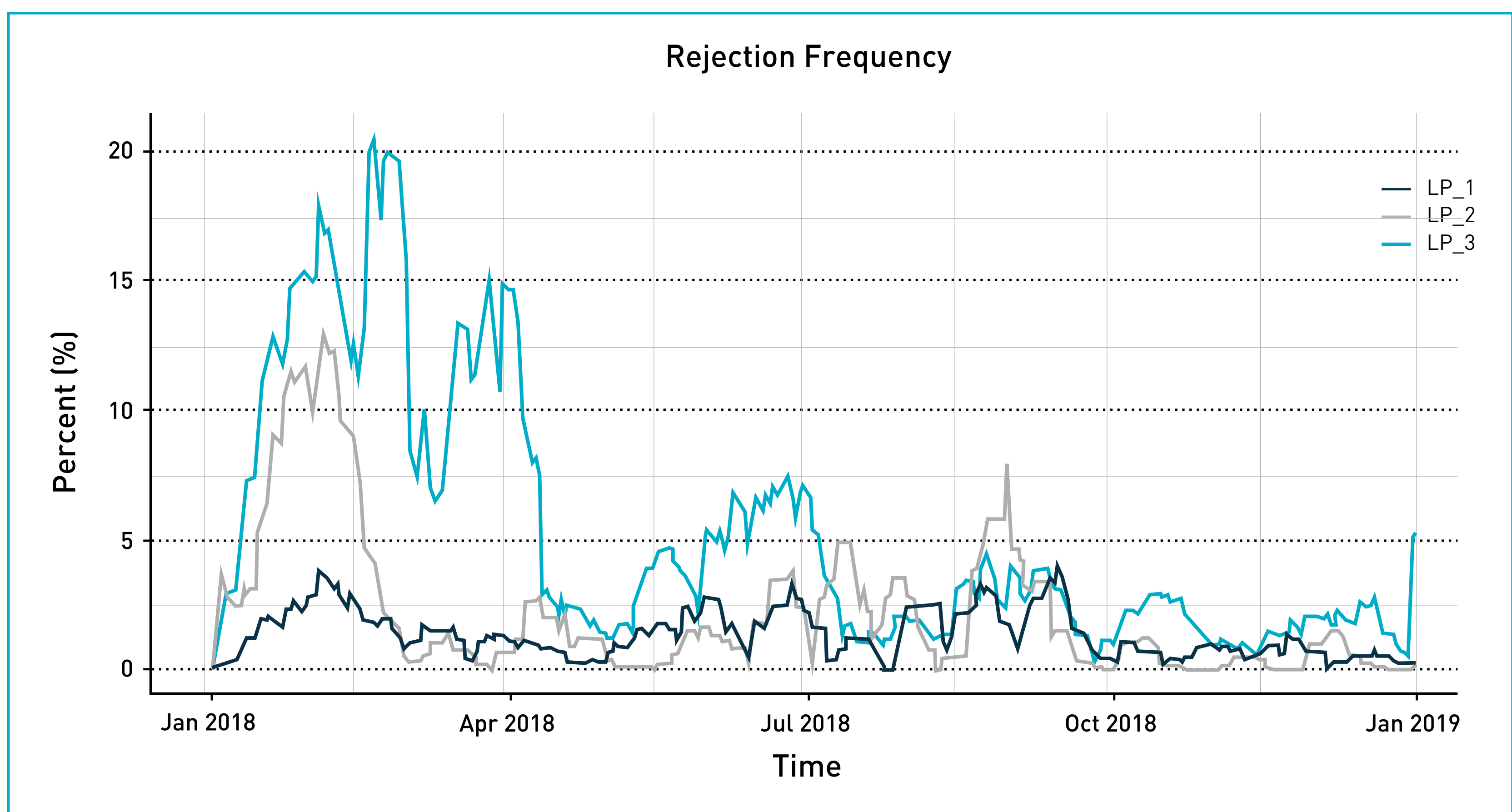
Penalty weights could be added to visible spread on venues or LPs that have high cost of rejects. For example, it may be advantageous to trade on a slightly wider price from a firm venue, rather than a slightly tighter visible last-look quote from an LP with poor historical fill rates. In the worst examples, it may even be worthwhile removing an LP completely.



Measuring visible and effective spreads provides a more rounded assessment of execution cost

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q **[CORE METRICS: FILL RATIO]** E J X B Y D
 F H B M Y D A simple but important metric X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Typically measured as $(\text{Accepted Volume} / \text{Attempted Volume}) * 100$.
- Monitored to ensure liquidity providers are honouring the prices shown (i.e. visible spread = effective spread).
- Low fill ratios are problematic and could be an indication of latency or portfolio selection.
- Liquidity from an LP with a 75% fill ratio is not comparable to that of another LP with a 95% fill ratio and spreads should not be compared like-for-like.
- The below example illustrates how reject rates vary considerably per LP. However, this can be reduced upon request. For example, LP3 in the below example reduced their reject rate from 20% in March 2018 to under 5% in January 2019 through determined action by the client - CMC Markets. This increases determinism for the client and reduces the potential for slippage.



Graph: Source Tradefeedr - CMC Markets.

Minimum fill ratio requirements help to ensure liquidity standards are upheld

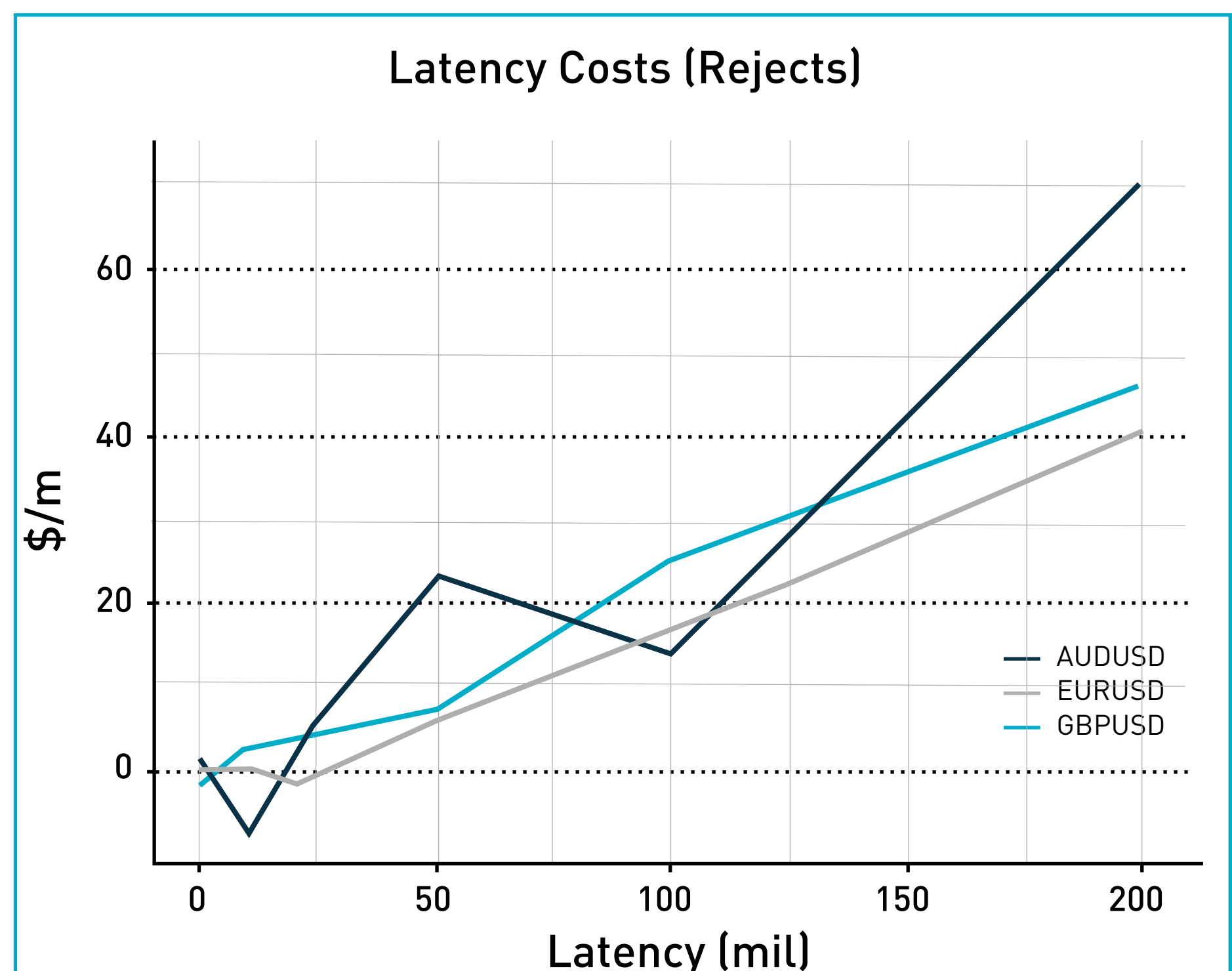
T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D **[CORE METRICS: \$ COST OF REJECTS]** X B Y D
 F H B M Y D A Not all rejects are equal R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- This factual measurement calculates the difference between the rejected trade price vs the re-try price that was accepted.
- The modelled measurement would typically use 100ms as a proxy for the re-try horizon, capturing the immediate change in mid-price.
- Allows clients to dollarize the rejects and take action against LPs whose rejections are expensive.
- This cost is a wealth transfer from the client to the LP who has avoided potential loss making trades and should not be tolerated.

Example

Rejection cost is highly correlated with the last look hold time duration.

CMC Markets found that their cost of rejection reduced significantly by lowering the latency (last look hold time) of their LPs. In GBPUSD, rejection cost was observed to be ~\$25p/m when the latency was 100ms. With latency lowered to 25ms, the rejection cost fell significantly to less than \$10p/m. Clients should strongly consider reducing the hold time of their LPs to reduce their cost of rejection.



Graph: Source Tradefeedr - CMC Markets.

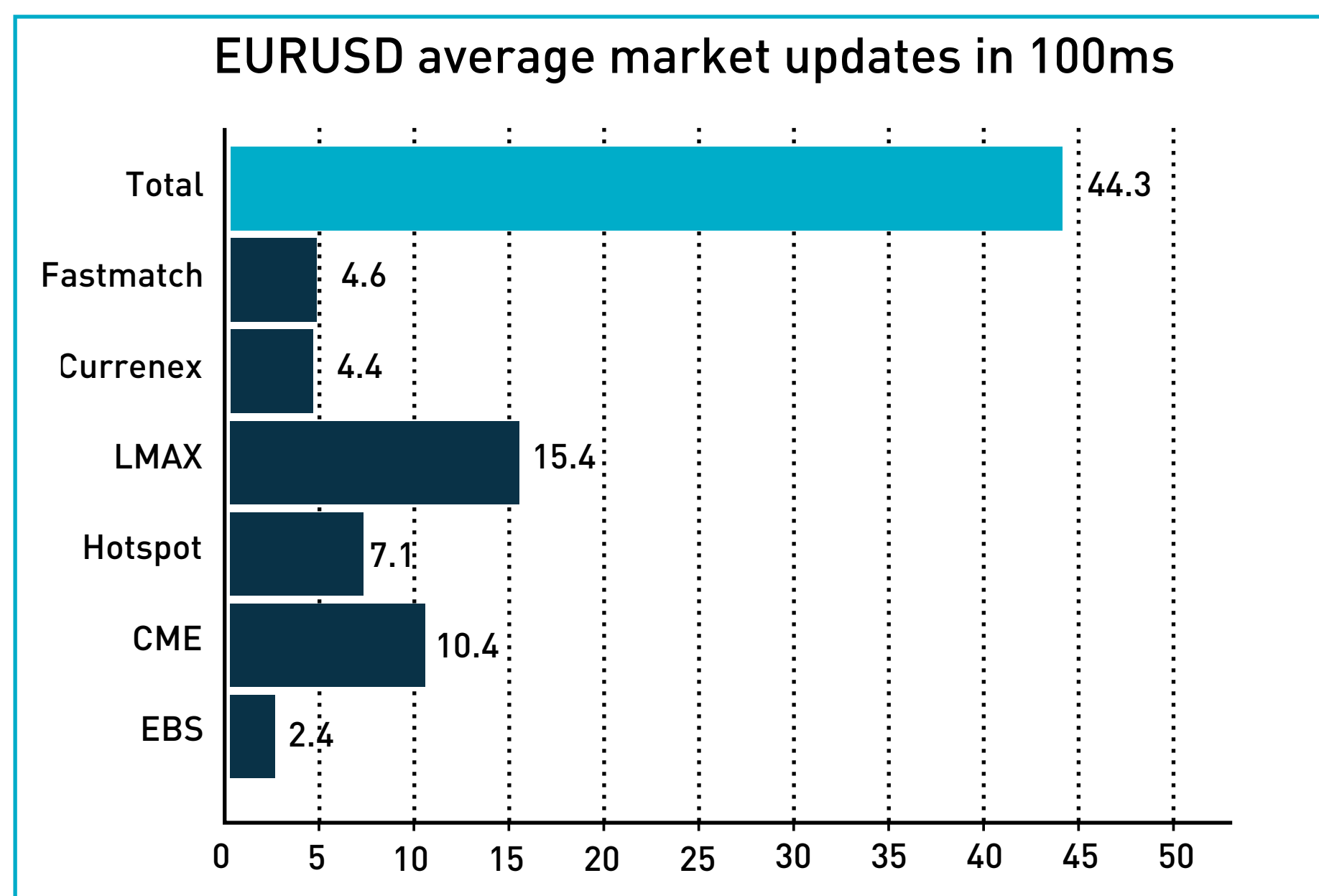
Measuring the \$ cost of rejects is crucially important as two LP's with the same fill ratio may have very different cost of rejects

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N **[CORE METRICS: LAST LOOK HOLD TIMES]** B Y D
 F H B M Should align with primary market updates K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Hold times vary significantly across LPs, but why is this? Put simply, longer hold times provide more optionality for the LP.
- Why would an LP need significantly longer than the primary market update to perform an on-market check?
- Any last look hold time exceeding the update frequency for the venue of price discovery should be questioned, as it is open to heavy adverse selection. Clients should separately measure last look hold times of rejected trades and question any significant differences.
- At a minimum, if LPs are allowed to impose long hold times, make sure you know why and what they do with this extended time.
- 100ms in EURUSD would allow approximately 44 updates on average across 6 FX platforms typically used for price discovery.
- NEX stated that the average hold time among their top 10 LP's on EBS Direct was 37 milliseconds - FX Week (2018). Several LP's even offer zero, or close to zero, hold times.

EBS	5ms
Reuters	25ms (soon 5ms)
ParFX	5ms
CME	Real-time
Currenex	Real-time
CBOE FX	Real-time
Fastmatch	Real-time
360TGTX	Real-time
Disclosed LPs	Real-time

Table: Figure produced by XTX Markets



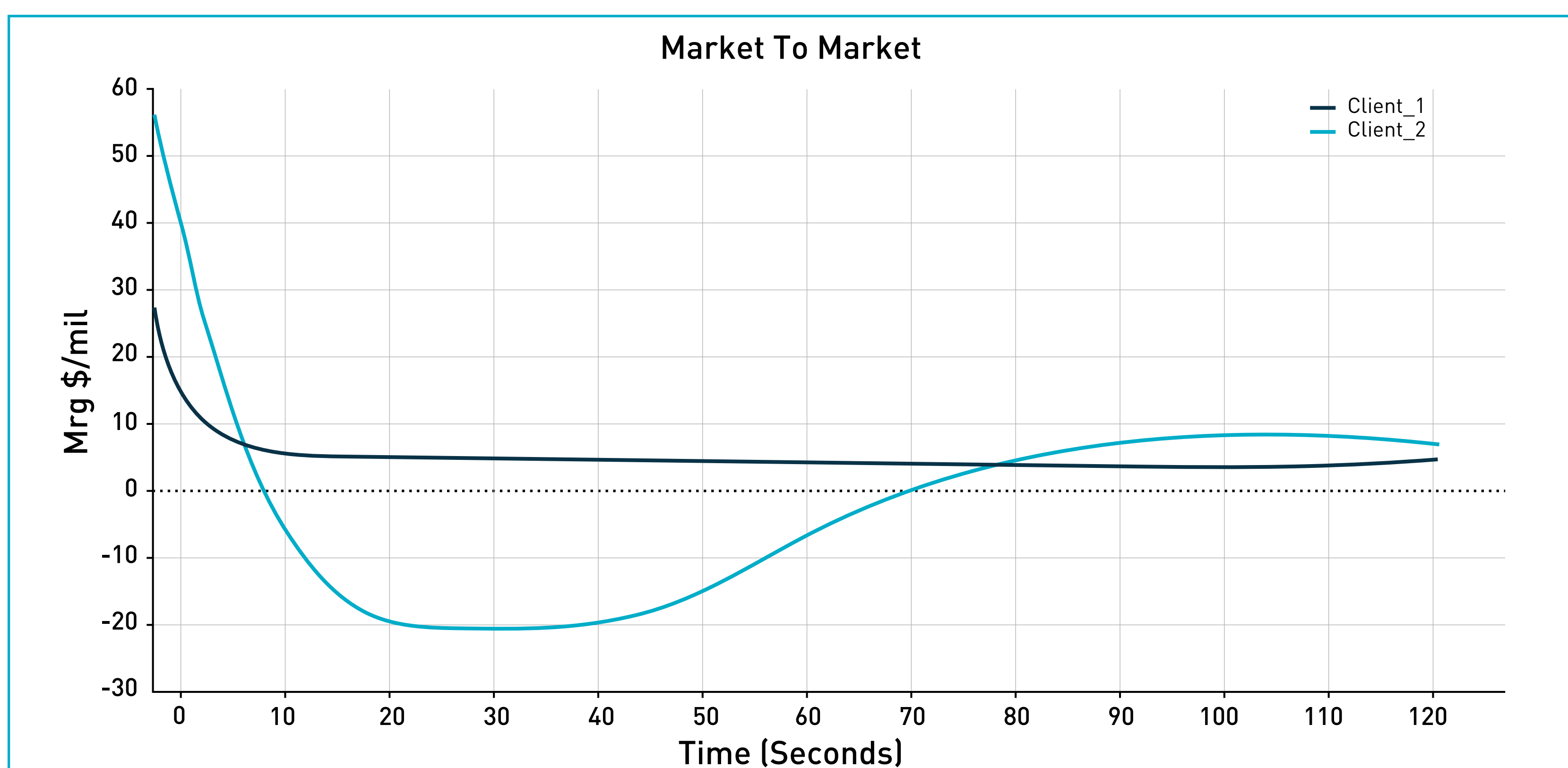
Graph: Figure is derived from ECN data [06:00 – 16:00 30/07/2018 – 26/10/2018]

[Lower hold times reduce the potential for adverse selection]

[CORE METRICS: MARKET IMPACT]

Highly correlated with inception spread

- Lower market impact allows risk-holding LPs to show tighter spreads due to the ability to warehouse the risk and hedge over a longer time horizon. Conversely, higher market impact results in LPs quoting wider spreads to cater for the faster decay of inception spread.
- In the high impact scenario this creates a vicious circle, as LPs hedging behaviour will likely adjust to be faster over time as impact is observed and a feedback mechanism occurs within their hedging models.
- Supply and demand dictates the speed at which an LP can hedge, which varies significantly by currency and time zone. These hedging horizons may be far longer than expected. For example, according to Butz and Oomen (2018) the average internalisation time for a tier one LP per \$mn of NOK during London hours is 11 minutes.
- Reducing market impact allows LPs to show tighter spreads and also reduces costs of future trades for clients executing a TWAP. The below example illustrates how the client with lower market impact pays \$25p/m less inception spread.



Graph: Figure is purely illustrative and not based on real data.

[Optimising for low market impact allows participants
to reduce spreads and execution cost]

T	S	Y	Z	E	S	D	C	O	R	Y	L
G	L	I	Q	U	I	D	I	T	Y	S	K
A	S	O	U	R	C	E	S		&	O	V
Q	C	U	R	A	T	I	O	N	F	N	C
S	R	L	B	J	D	Q	Y	G	K	P	M

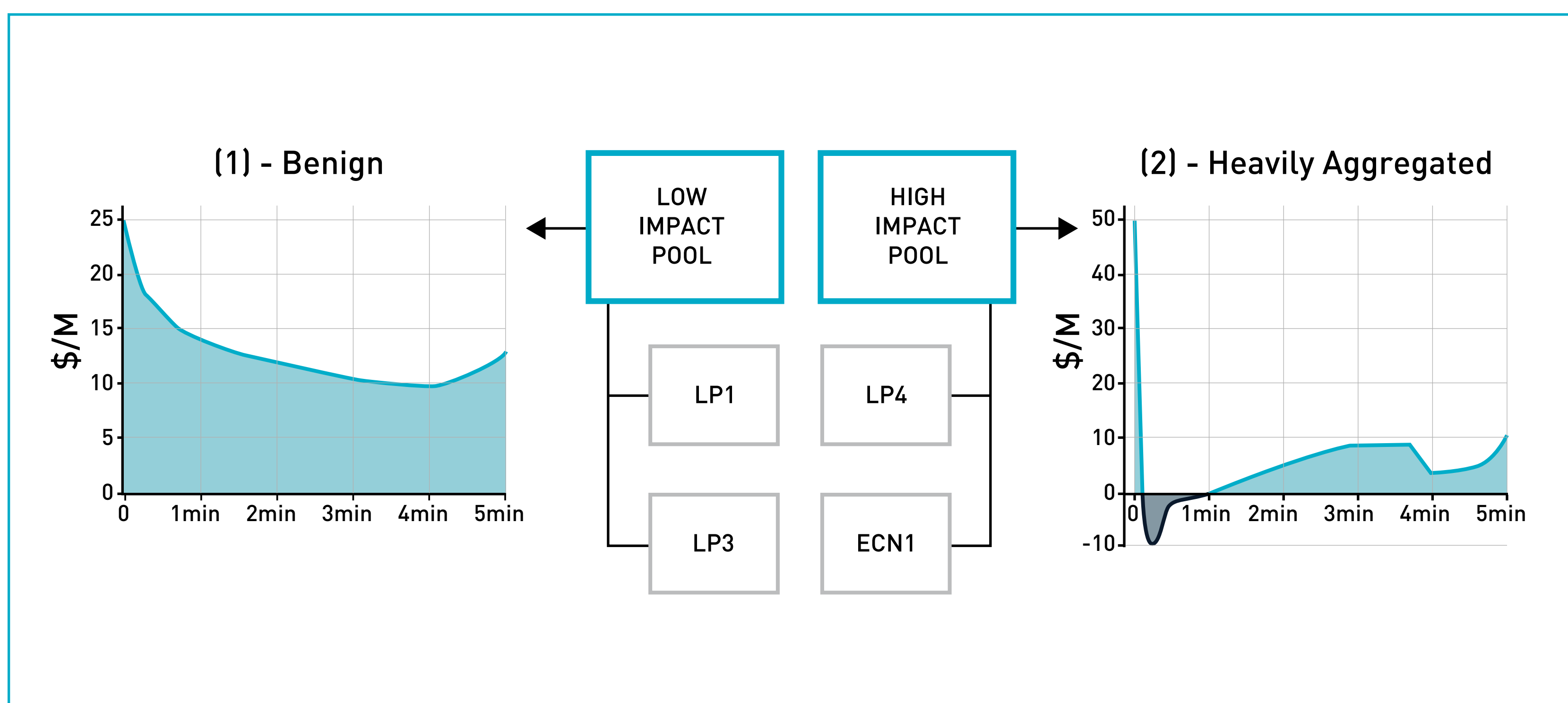
Group complementary sources together

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[LIQUIDITY POOLS]** R Z E J X B Y D
 F H B M Y D Grouping compatible sources X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Clients should aim to create pool(s) of LPs with similar pricing and hedging models. E.g. low market impact.
- Co-mingling sources that diverge in their characteristics, such as varying reject rates, can be problematic, as all LPs iterate towards the lowest common denominator.

Example

- Consider a client who aggregates both high and low impact liquidity together. This may be aggregating anonymous ECN liquidity, where the LPs operate faster hedging models, with bilateral LPs who aim to hold risk.
- These two sources are very different in nature and often do not comingle well – likely resulting in a domino effect whereby all of the client’s liquidity deteriorates. In this example, the benefit of consuming bilateral liquidity may be lost. By grouping liquidity appropriately, clients are likely to benefit from tighter pricing and more consistent liquidity.

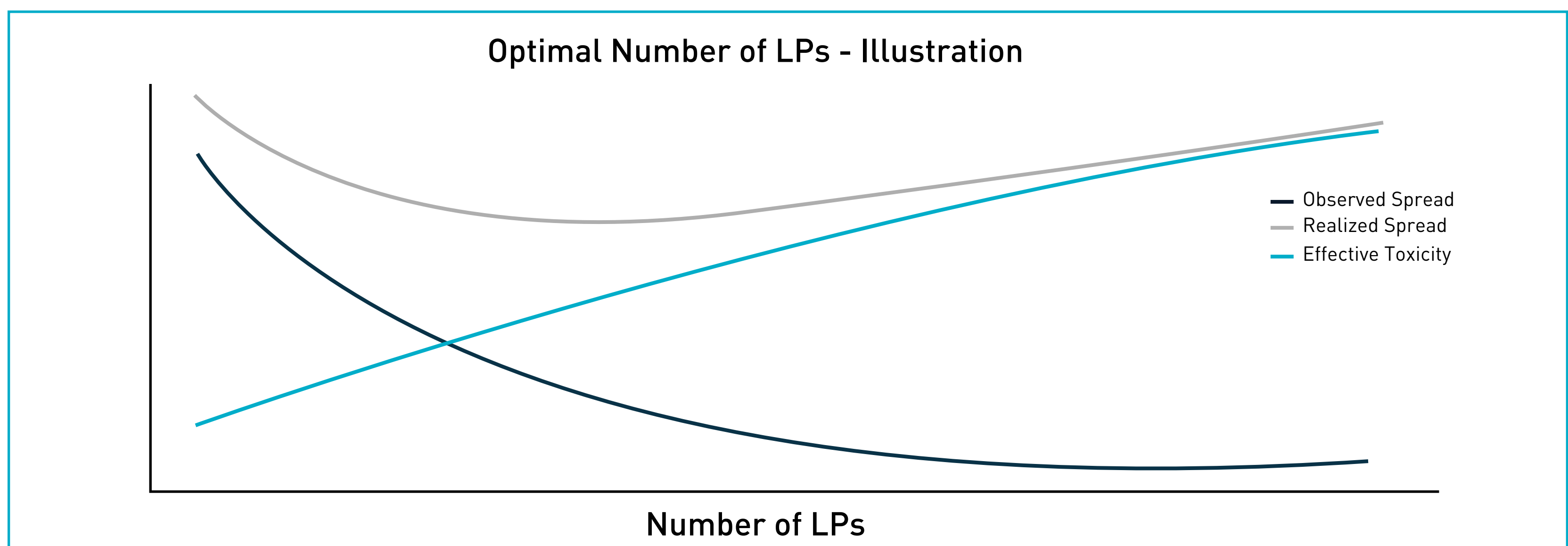


Graph: Figure is purely illustrative and not based on real data.

[Curating liquidity pools helps to optimise pricing]

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q **[OPTIMAL NUMBER OF LP'S]** E J X B Y D
 F H The LP mix may be more important than the number T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Over aggregation in a sweep environment typically results in faster post-trade decay due to the prisoner's dilemma faced by providers. On the surface, visible spreads may be tighter but effective spreads are wider due to higher flow toxicity which leads to rejects and slippage.
- In a Full Amount environment, too many LPs can result in the 'winner's curse' observed in Deutsche Bank (2019), i.e. there is an increased chance that this LP won the trade by pricing it incorrectly and thus being adversely selected.
- Consider conducting an experiment to see what is the optimal number and LP mix for **your** liquidity pool.
- Creating an LP pool of complementary pricing and hedging styles is key and whilst the number of LPs is important, it may not be the most important component. Clients are likely to find diminishing returns by adding more than an optimal number of LPs.



Graph: Figure created by XTX Markets, inspired by Tradefedr.

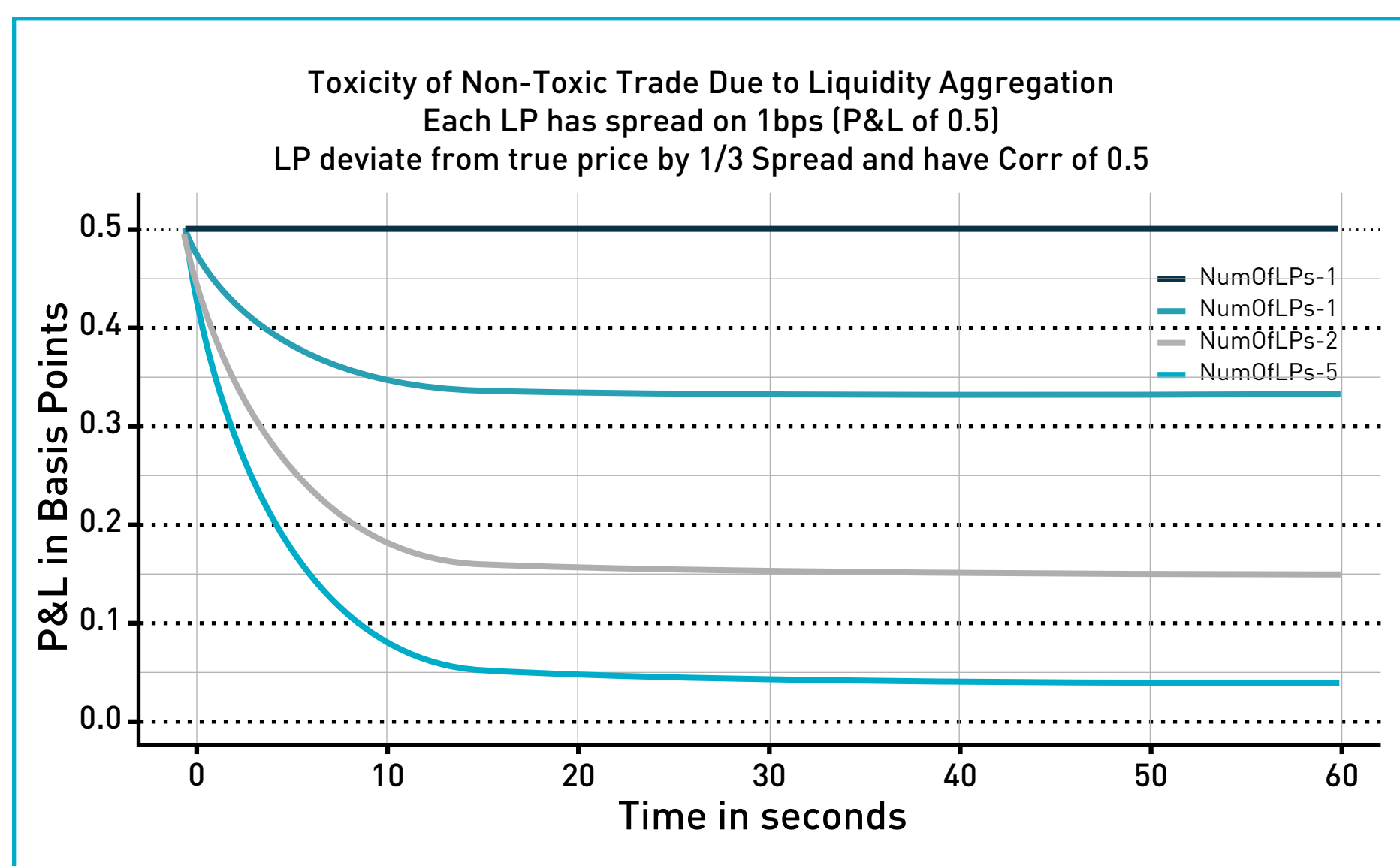
“While it is important to optimize the number of liquidity providers, it is equally important to aggregate LPs based on type and execution style. The aggregator should consist of LPs who minimise market impact to reduce our hedging cost, otherwise one LP can effectively force other providers to join them in externalising flow. Based on our requirements, we have found that an optimal number of liquidity providers is between 8 and 10. However, this number can vary depending on the trader’s requirements.”

CMC Markets

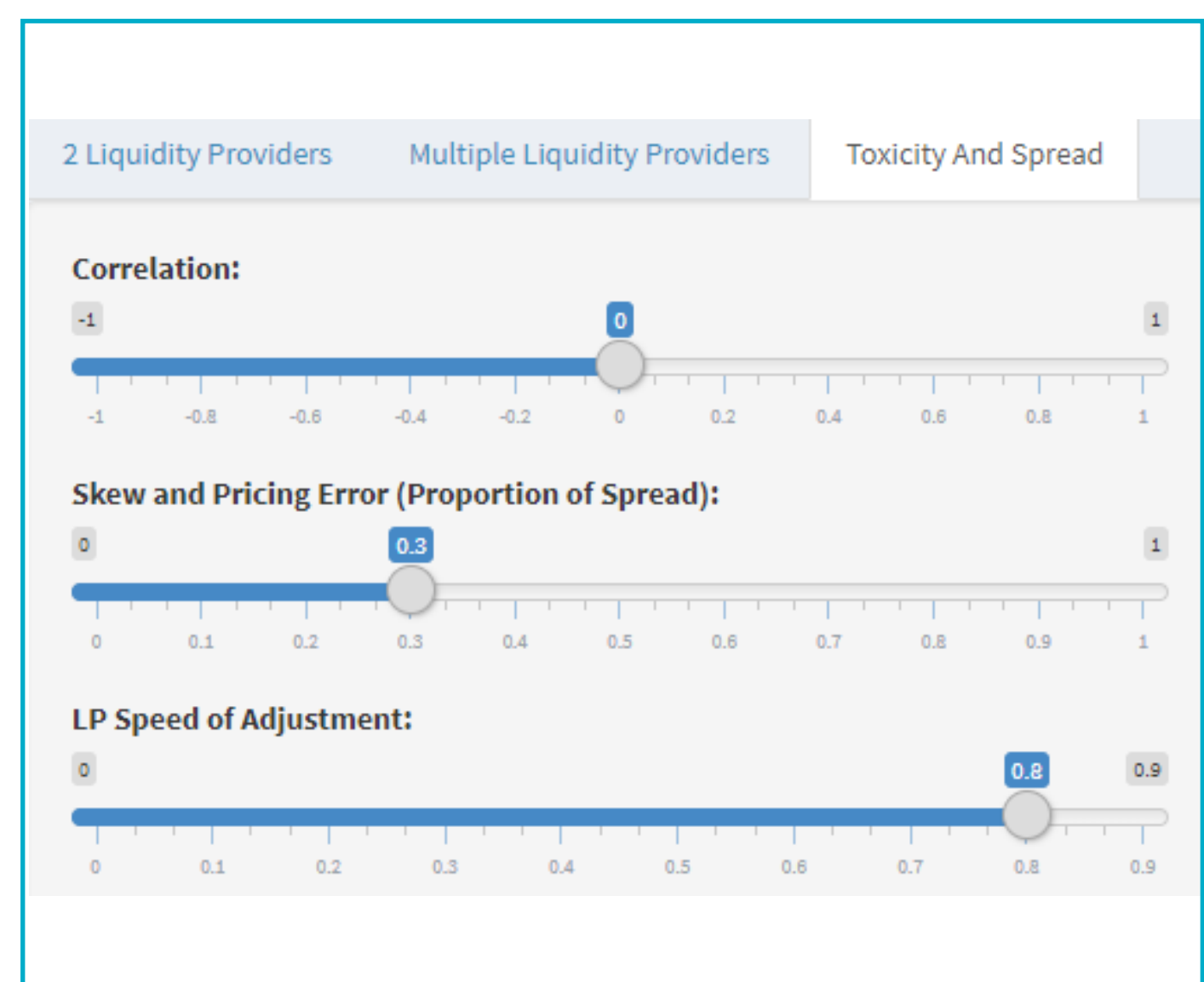
This process doesn't need to be theoretical – there are tools to help

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[OPTIMAL LP MIX]** R Z E J X B Y D
 F H B M Y D **Tradefedr - analytical approach** X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Arriving at the efficient frontier between visible spread, effective spread and flow toxicity is vital for a participant to maximise the quality of liquidity they receive.
- Two clients, who on paper may look very similar due to their execution style and number of LPs, may receive very different liquidity due to which LPs they have or even how the same LP prices differently – such as the amount of skew shown.
- It may well be that the number of participants is less important than the characteristics. E.g. a lower number of uncorrelated risk holding LPs are better than a larger number of correlated externalising LPs.
- Consider using an analytics tool such as Tradefedr to achieve the optimal number and mix of LPs for your liquidity pool.



Graph: Source Tradefedr

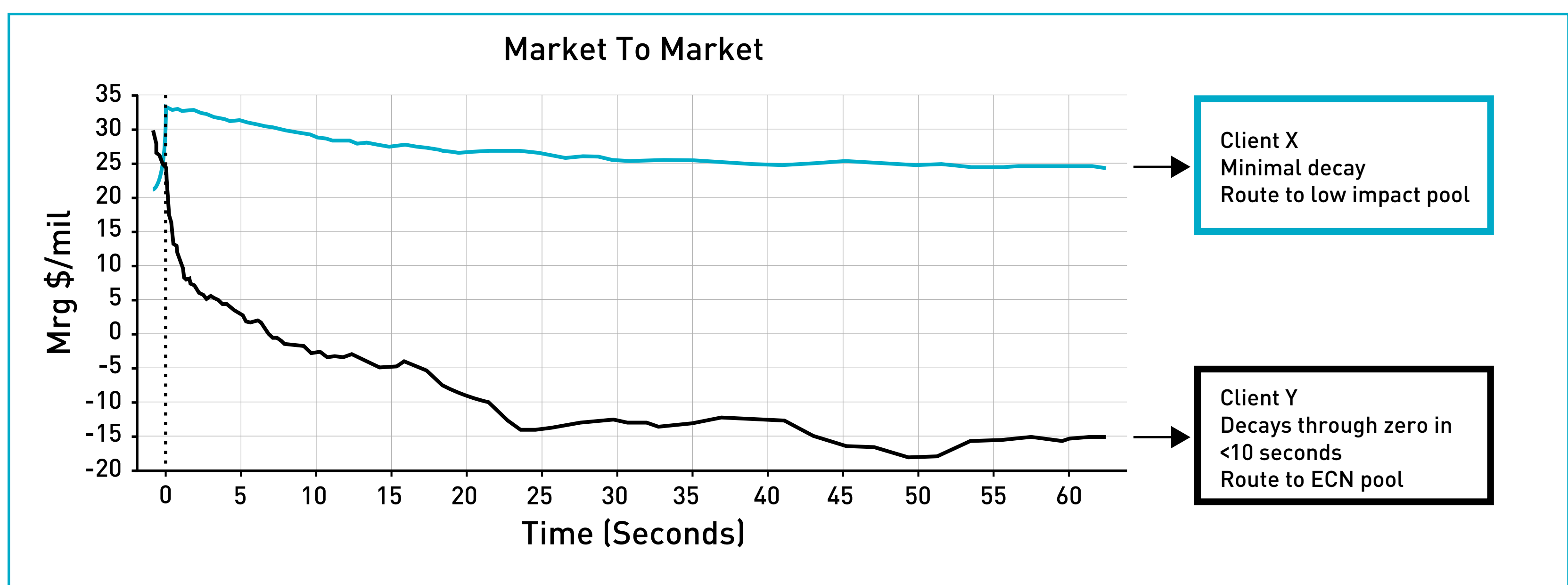


T	S	Y	Z	E	S	D	C	O	R	Y	L
G	O	P	T	I	M	I	S	I	N	G	K
A	E	X	E	C	U	T	I	O	N	O	V
Q	E	O	H	F	X	K	S	B	F	N	C
S	R	L	B	J	D	Q	Y	G	K	P	M

Routing flow to appropriate sources

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S **[SEGMENTING FLOW]** Z E J X B Y D
 F H B M Y D A Finding suitable pricing R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Flow sent to LPs should be segmented in a similar way to client pricing (e.g. by market impact) and routed to the most appropriate source
- High impact flow where inception spread is lost within 10 seconds, should not be routed to a pool of risk holding LPs who typically hedge over multiple minutes.
- Conversely, flow which has very limited market impact and decays gradually over many minutes, should not be routed to a pool of LPs who operate faster hedging models.
- With segmentation, clients will find that the overall quality and consistency of liquidity improves as LPs receive flow that is compatible with their hedging model.



Graph: Figure is purely illustrative and not based on real data.

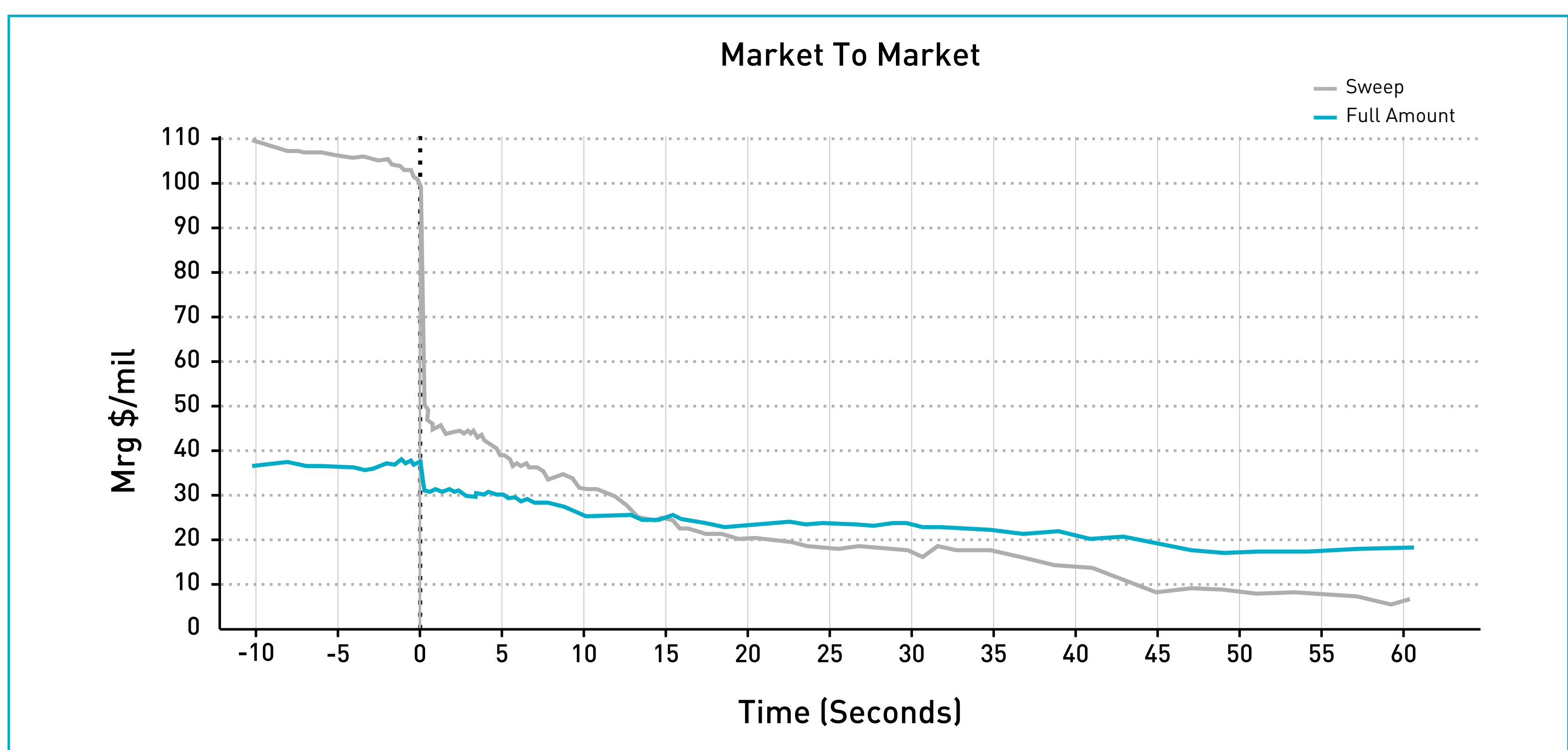
[Align LP hedging models with flow characteristics]

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q **[SWEEP vs FULL AMOUNT]** E J X B Y D
 F H B M Y D Which is better for your flow? X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

“Since formulating and utilizing a full sum execution liquidity pool as part of our risk management process, we have experienced increased depth of liquidity, reduced market impact on the back of our transactions and increased fill ratios from LPs which has resulted in a reduction of our execution costs”

Standard Bank South Africa

- Full Amount execution typically results in reduced market impact and tighter spreads as LPs are the only party to the trade and not forced to hedge quicker than they otherwise would intend to.
- Sweep execution may be ok for smaller size, but flow toxicity, and spreads likely increase with larger trade sizes. This is due to the prisoner’s dilemma, whereby LPs hedge faster than they otherwise would, because they are aware that other LPs also have the same risk.
- The decision to use Sweep or Full Amount will depend on various factors, such as the participant’s flow profile, the size of the trade and the currency pair to name just a few. These dynamics will also vary over time, making a single choice difficult to make.
- Clients no longer need to make a binary choice between the two – technology providers have built innovative solutions to compare the two in real-time and route according to the logic stated.



Graph: Figure is purely illustrative and not based on real data.

THE TRANSITION FROM SWEEP TO FULL AMOUNT

Can be a gradual process

- Switching to Full Amount in a big-bang style can be problematic.
- If previous flow via the sweep method has been toxic, this may result in LPs pricing Full Amount defensively.
- Why should the participant move flow over without proof of improved execution?
- Many software vendors now offer the ability to consume both feeds and route on best price (or the logic stated by the client), as explained in Clarke (2019).
- Experience has shown that LPs can show tighter pricing in Full Amount and therefore, flow naturally iterates towards this execution style. Clients therefore benefit from a smoother transition which is self correcting, without the need to cut-over without a guarantee of improved execution.

OFFER	
Sweep	Full Amount
50.4	50.2

Graph: Figure is purely illustrative and not based on real data.

← Full Amount is showing a better price to buy at – route here.

Ask your technology providers if they offer this functionality

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[LARGE ORDERS]** R Z E J X B Y D
 F H B M Y D **The rise of execution algorithms** X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Execution of large orders and the choice of method will depend on various factors; such as the participants appetite for holding risk, the liquidity they have access to and the size of the order.
- Participants may now elect to utilise an execution algorithm for orders over a certain size, participating in the market over the life of the order, rather than risk transfer with bilateral LPs as discussed in XTX Markets (2018).
- Clients should also be cognisant of the signalling risk associated with this form of execution, carefully assess the underlying logic of each offering and be aware of the potential for market drift – Quantitative Brokers (2018)
- In the absence of execution algorithms, clients should also consider creating a segmented risk-transfer pool for particularly large size. This may take the form of routing particularly large orders that must be traded in a short-space of time to anonymous venues. If clients route large orders to the regular stream, spreads may widen in the future to cater for the increased impact observed.

Execution algorithms offer an alternative to risk transfer liquidity, often suitable for large size

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D **[SINGLE OR MULTI DEALER PLATFORM]** X B Y D
 F H B M Y D A B A common question P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- MDPs can save significant amounts of spread by aggregating multiple LPs and their respective skews.
- However, the perceived downside is that one may be rejected in fast markets vs a SDP that honours its prices.
- Participants should ask LPs to quote into the MDP using the same logic as on their SDP.
 - Remember: there is no technological reason not to do so, since SDPs are also available via the internet and thus have similar latency.
 - The LPs simply need to use the same last look trade acceptance logic as they already do on their SDP.
- There is no reason why in the right set-up, LPs couldn't price the same over an MDP vs an SDP (Full Amount with very high acceptance rates) allowing the client to benefit from tighter pricing due to aggregation of diverse skews. Remember it is the skew that is being aggregated, not the liquidity.

	Bid	Offer	Spread
Best	30.1	30.5	0.4
LP1	30	31	1.0
LP2	29.5	30.5	1.0
LP3	30.1	32	1.9

Graph: Figure is purely illustrative and not based on real data.

[MDPs reduce spreads by aggregating and competing LPs pricing]

T	S	Y	Z	E	S	D	C	O	R	Y	L
C	M	C		M	A	R	K	E	T	S	K
A	C	A	S	E		S	T	U	D	Y	V
Q	E	O	H	F	X	K	S	B	F	N	C
S	R	L	B	J	D	Q	Y	G	K	P	M

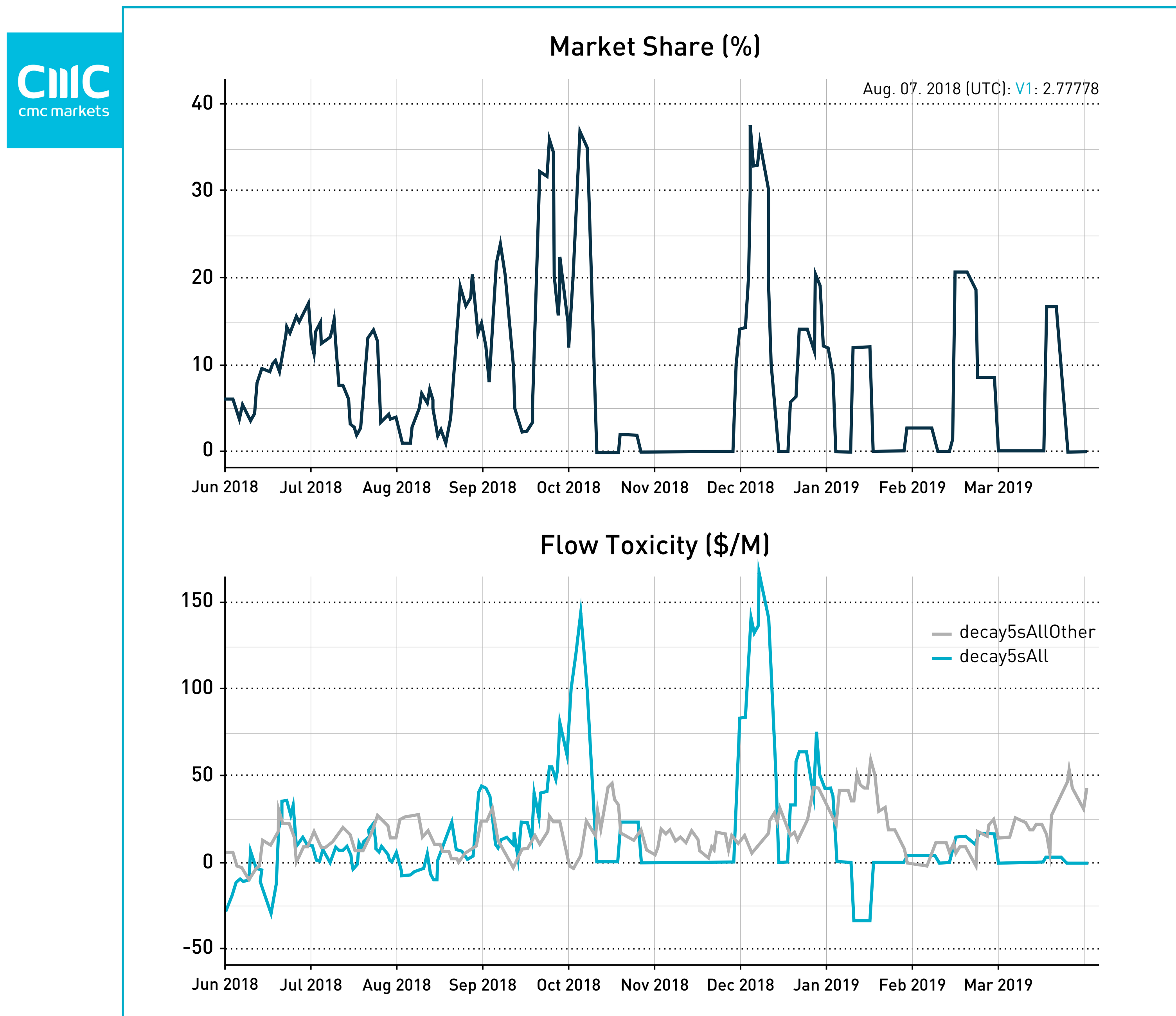
T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[MARKET SHARE]** R Z E J X B Y D
 F H B M Y D A **Does it tell the full story?** R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

Market share is an important metric but clients should look beyond this to fully assess an LPs performance.

Is an LP winning market share at the expense of increased market impact?

CMC Markets identified an LP whose market share growth also coincided with increased flow toxicity of \$100-150p/m – an outlier vs the remaining LPs in the pool.

CMC Markets changed their routing logic to bypass this LP on sweeps due to the excessive market impact observed resulting in reduced overall flow toxicity.



Graph: Source Tradefeedr - CMC Markets.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U Y **[LAST LOOK]** H R Z E J X B Y D
 F H B M Y D A B **The cost of waiting** P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

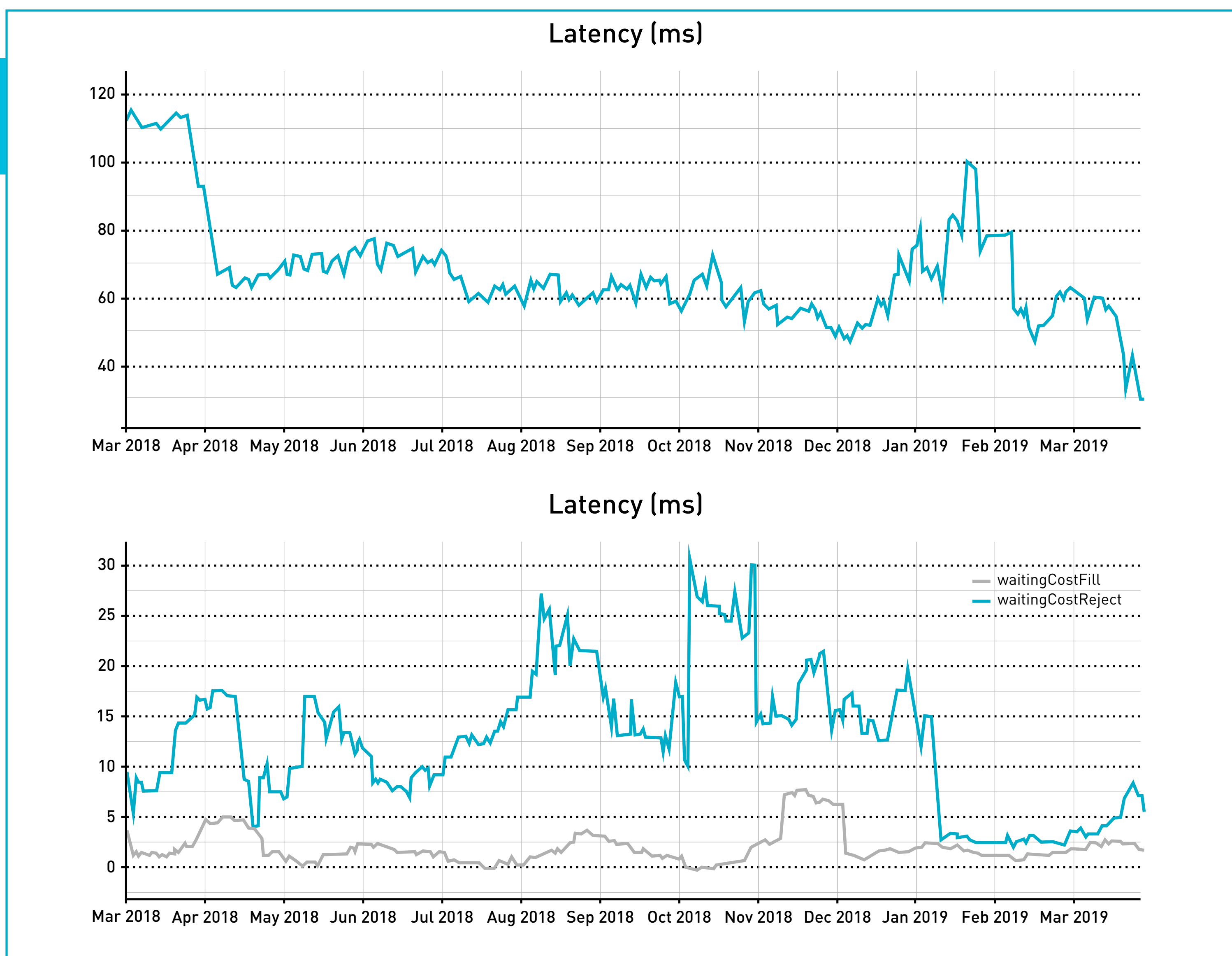
The cost associated with longer last look hold times may surprise some participants.

This cost arises due to the optionality granted to the LP who can reject the trade after an unfavourable market movement, requiring the client to re-attempt at a worse price later on.

CMC Markets measured the 'waiting cost' and found that this was \$10-30p/m, a substantial amount in volume terms.

By requesting LPs to reduce their hold times, CMC Markets reduced the waiting cost to under \$5p/m, a significant saving.

Lowering last look hold times reduces rejection costs as LPs have less optionality.



Graph: Source Tradefeedr - CMC Markets.

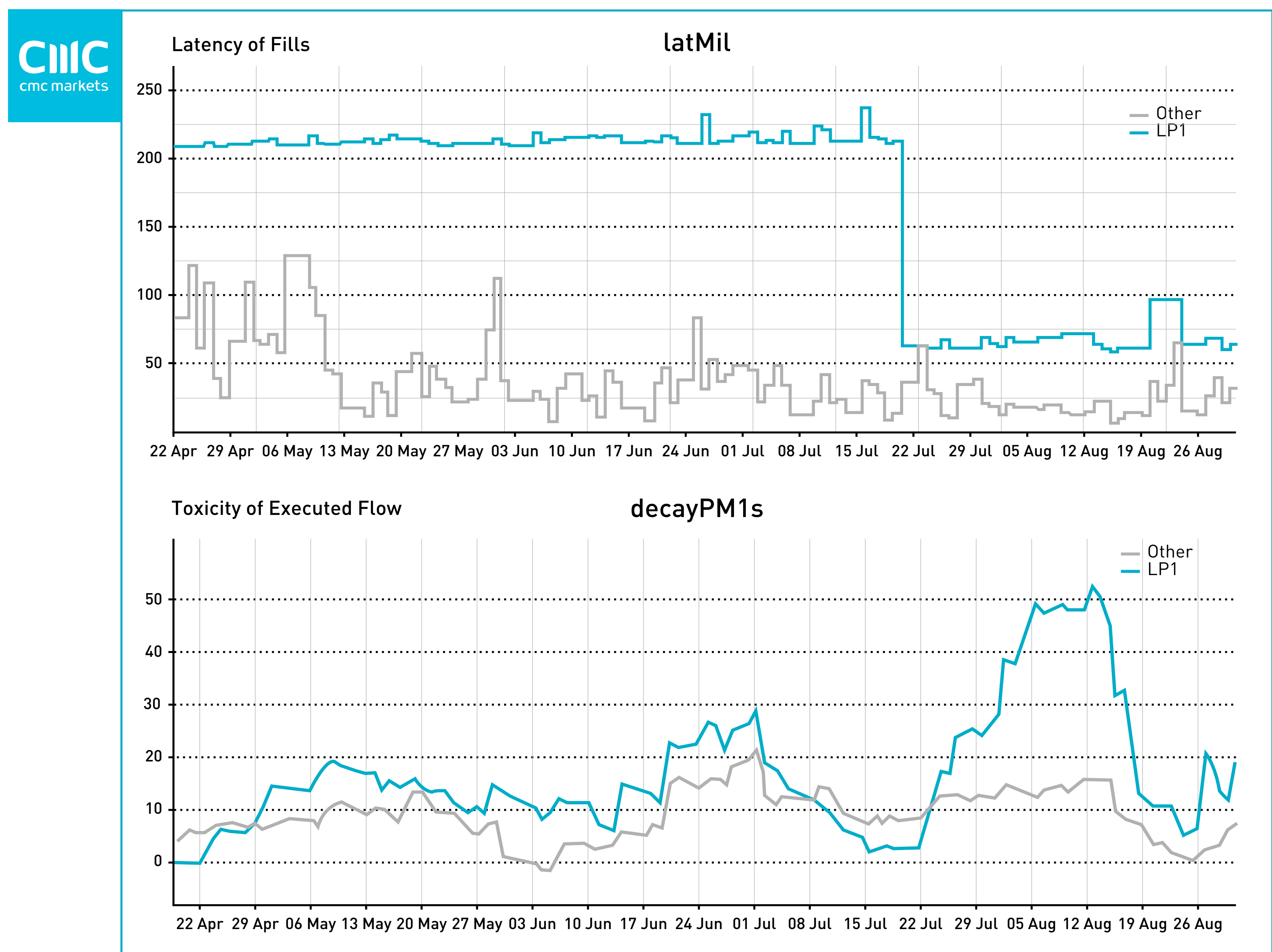
T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S **[REDUCING HOLD TIMES]** Z E J X B Y D
 F H B M Y D **Keep an eye on market impact** X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

Clients should carefully monitor market impact when requesting LPs to reduce their last look hold times.

CMC Markets requested that an outlier LP reduce their hold time from 200ms, a positive step towards reducing adverse selection.

This change also coincided with a spike in that LPs post-trade decay measured at 1 second from \$35p/m to \$40p/m.

Upon raising this with the LP, the decay subsequently improved. However, this highlights the need to monitor all aspects of an LPs liquidity provision.



Graph: Source Tradefedr - CMC Markets.

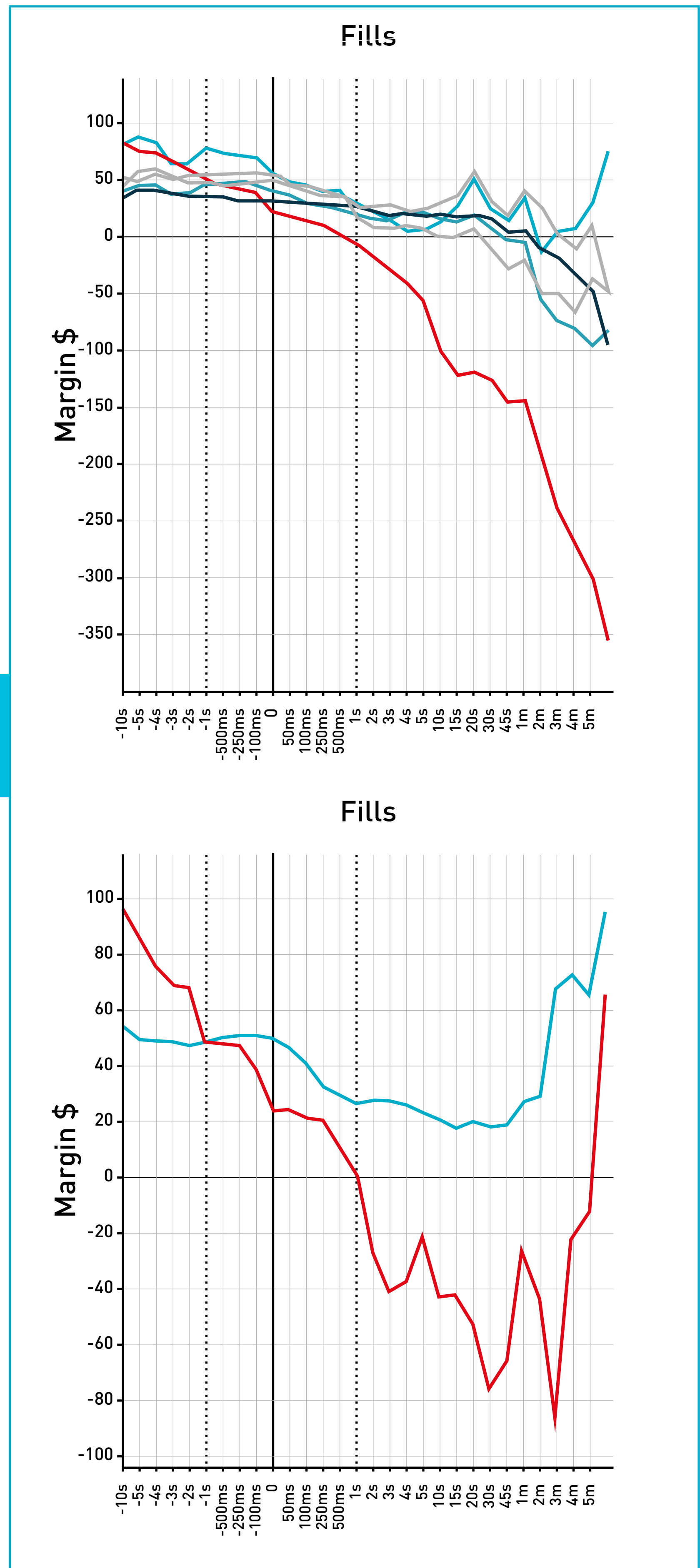
T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[MARKET IMPACT]** R Z E J X B Y D
 F H B M Y D A B Q **Mixing liquidity** O P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

CMC Markets aim is to maintain a low impact pool of risk holding LPs to preserve the tightest spread possible.

- The LP shown in red was observed to have excessive market impact in Gold.
- This suggested heavy skewing immediately post-trade as inception spread was lost in 1 second.
- The aggregate market impact of the pool degraded as other LPs were affected by this hedging behaviour, with most LPs losing inception spread 30-60 secs post-trade.



- CMC Markets removed this externalising LP and found the aggregate market impact of the pool to significantly improve (blue line) – never decaying through zero.
- The high impact LP (red line) was moved to their ECN pool and used for higher impact flow that better suited their hedging profile.
- A paper by Oomen (2018) provided a comparison of internalising vs externalising LPs.



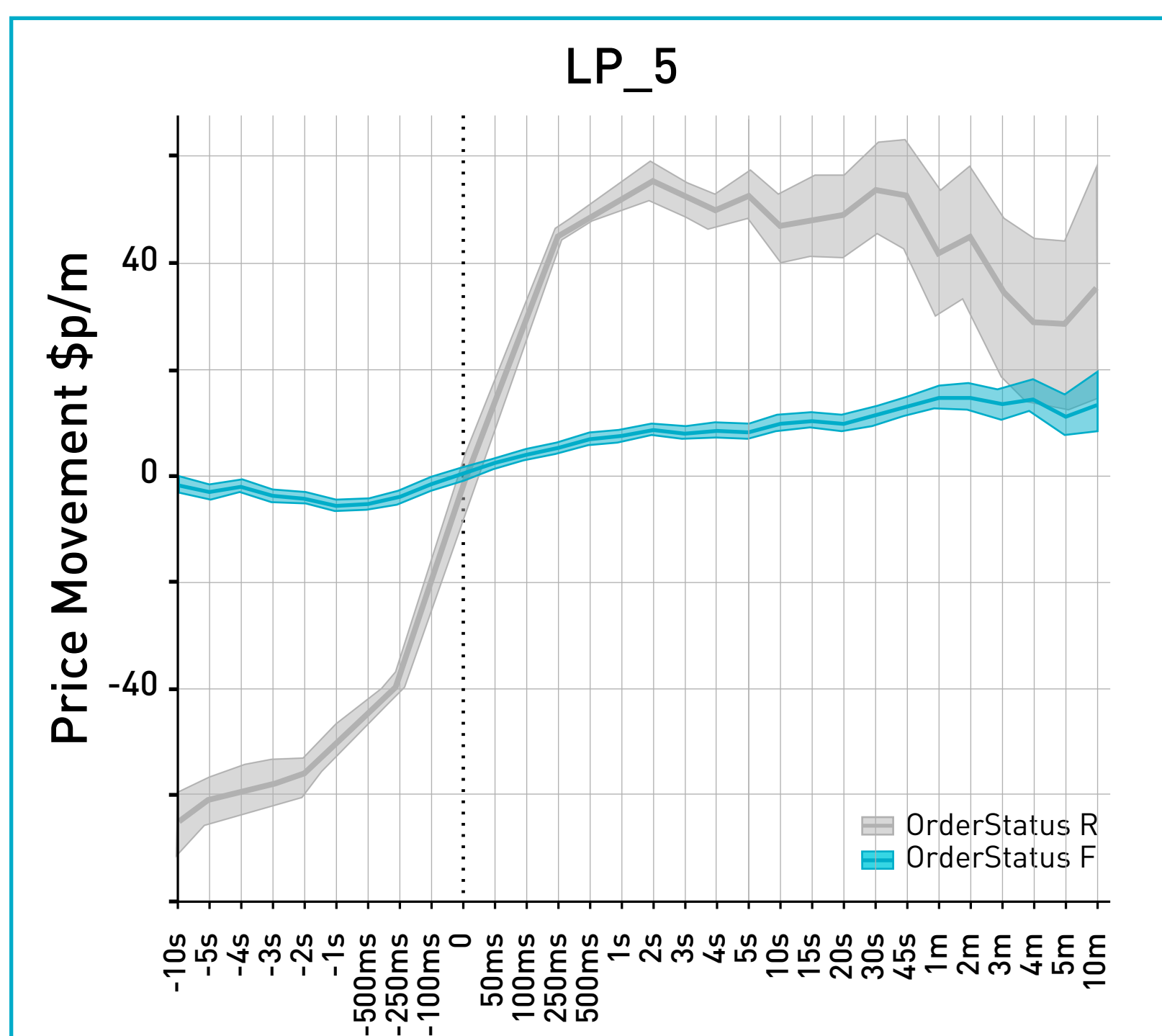
Graph: Source Tradefedr - CMC Markets.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q **[MARKET IMPACT CONTINUED]** E J X B Y D
 F H B Rejected trade portfolios can be very insightful G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

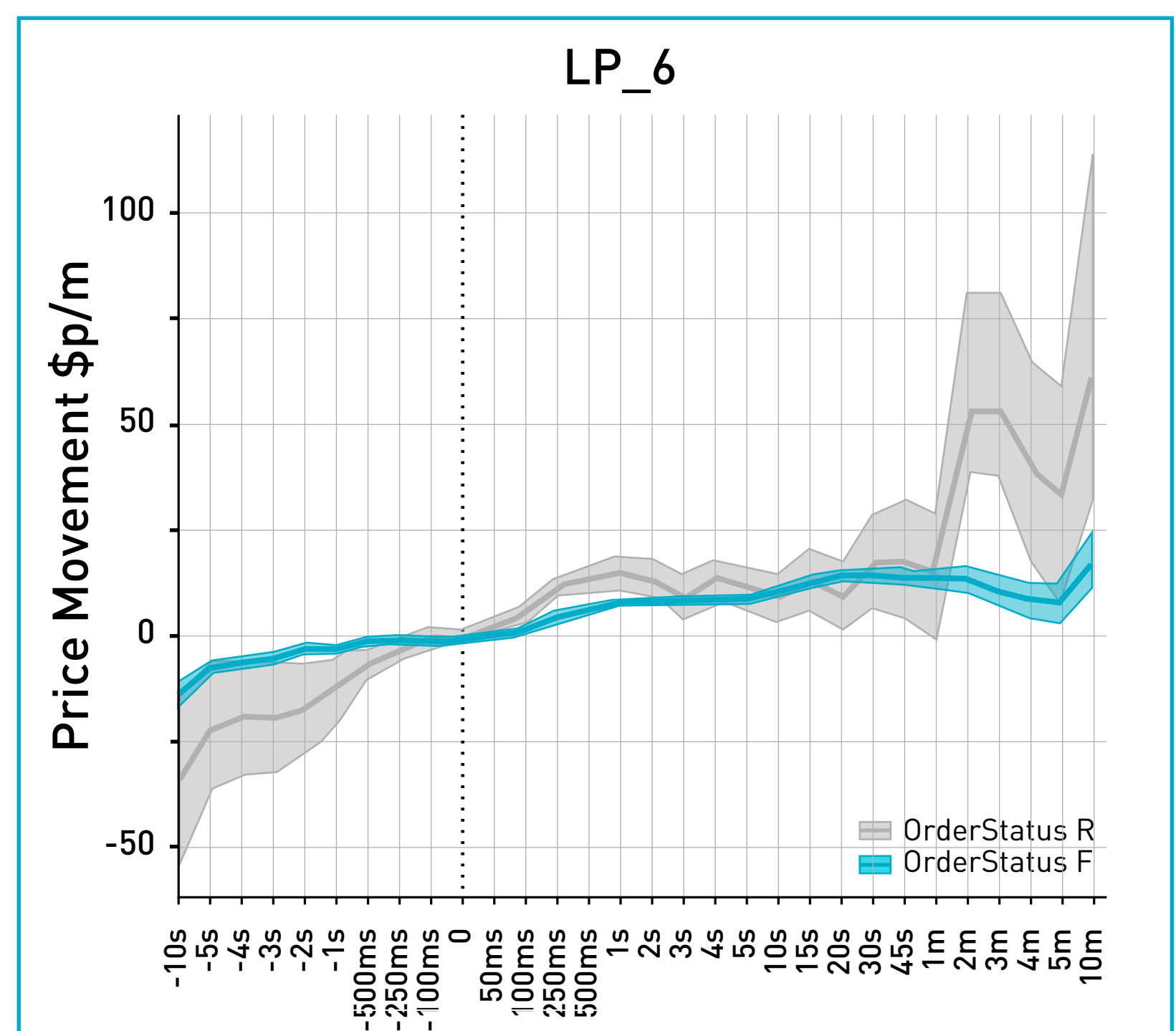
- The market impact of rejected trades, specifically the difference vs. accepted trades, can highlight the use of asymmetric last look.
- Cost of rejects captures the immediate move following a rejection, although the extended profile of these rejects is likely the market impact profile for the LP who wins the re-submission and accepted the trade.
- This LP who accepted is then left with tougher flow and may even appear as the cause of impact. LP's in this situation will likely widen over-time, increasing concentration risk for the taker and reducing the benefit of aggregate skews.
- Conversely, the LP who rejected the original order may appear as a 'good' LP by using last look to avoid loss making trades. Measuring the market impact of rejected trades provides a more comprehensive measure of LP performance.

At 100ms post-trade there is a \$40p/m difference between filled (blue) and rejected (grey) trades. This data suggests asymmetrical last look is being utilised by LP5.

LP6 on the other hand has minimal divergence between filled and rejected trades – suggesting symmetrical last look and consistent behaviour.



Graph: Source Tradefeedr - CMC Markets



Graph: Source Tradefeedr - CMC Markets

Participants should monitor rejected trades impact and question contrasting profiles

T	S	Y	Z	E	S	D	C	O	R	Y	L
G	J	T	U	L	P	A	E	X	F	S	K
A	C	O	N	C	L	U	S	I	O	N	V
Q	E	O	H	F	X	K	S	B	F	N	C
S	R	L	B	J	D	Q	Y	G	K	P	M

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G U T Y Z E S D C O R N Q K E X
B Y N D E Q S **[WHAT CAN YOU DO?]** Z E J X B Y D
F H B M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F R O V

- Consider building internal analytics or using a third party analytics product to better understand and improve the quality of pricing you receive from LP's.
- Contact your technology provider to see if they offer the Full Amount price comparison functionality mentioned on page 18 & 19 of this paper. You may find that this is very beneficial to your execution.
- Ask your liquidity providers the questions on the following page to better understand their pricing and disclosures.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G U T Y Z E S D C O R N Q K E X
B Y N D **[QUESTIONS TO ASK YOUR PROVIDERS]** X B Y D
F H B M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F R O V

■ What are your typical hedging horizons for my flow?

■ Disclosures and definitions

- Are you signed up to the FX Global Code? www.globalfxc.org
- What is your definition of Last Look and does it align with that of the FX Global Code?
- What last look hold time do you impose for my flow and is this the same for acceptances and rejects?
- If you utilise a last look window that is significantly greater than the tick intervals of primary markets, why is that?
- Do you utilise symmetrical or asymmetrical last look?
- Do you pre-hedge during the last look window?
- Do you utilise rejected order information as an input into pricing?

■ Will you offer me Zero Hold Time pricing?

- Many LPs now offer zero or close to zero hold time pricing.

■ Will you integrate with a third party analytics platform?

T	S	Y	Z	E	S	D	C	O	R	Y	L
G	J	T	U	L	P	A	E	X	F	S	K
A	H	A	D	D	E	N	D	U	M	O	V
Q	E	O	H	F	X	K	S	B	F	N	C
S	R	L	B	J	D	Q	Y	G	K	P	M

[DEFINITIONS]

- **Adverse Selection**
 - When one trading participant is systematically disadvantaged relative to the other, perhaps due to a technical issue such as latency or asymmetric information such as the trading intention revealed during the last look window before the order has been accepted.
- **Cost of Rejects**
 - Empirical: Measured as the difference between the attempted price that was rejected and the cover price that was subsequently accepted, dollarized.
 - Modelled: Measured as the mid-price movement post-trade following a rejection, such as 100ms where it is assumed the taker will re-submit a new trade request, dollarized.
- **Effective Spread**
 - Measured as: $\text{Spread Paid on Fill} + (\text{Reject Ratio} * \text{Reject Cost})$
- **Fill Ratio**
 - $\text{Accepted volume} / \text{Attempted volume} * 100$
- **Flow Toxicity**
 - A measure of how market impact is observed from a client's order flow. An increase in flow toxicity is generally considered bad and costly for providers of this liquidity.
- **Inception Spread**
 - The amount of spread earned by an LP at the initiation of the trade relative to the mid-price at that time. For example if an LP was quoting a spread of 50 – 51 to a client who sold to them at 50, the inception spread would be 0.5.
- **Last Look Hold Time**
 - Length of time that an LP holds a trade request before accepting or rejecting measured in milliseconds.
- **Market Impact**
 - Measures the mid-price movement following a trade, typically measured in minutes.
- **Portfolio Selection**
 - The process of selecting the best portfolio of trades, utilising last look to reject loss making trades.
- **Pre-hedging**
 - Practice by a liquidity provider who skews following the receipt of a trade request and during the last look hold time window – accepting if filled at a better rate or rejecting if not.

- **Prisoner's Dilemma**
 - The prisoner's dilemma is a standard example of a game analysed in game theory that shows why two completely rational individuals might not cooperate, even if it appears that it is in their best interests to do so. An example being two LPs who are part of a sweep, with the first to hedge being rewarded, despite impact being minimized by both holding onto the risk and hedging slowly.
- **Slippage**
 - When a consumer of liquidity executes at a worse price than originally intended due to a miss or rejection. E.g. trade attempt to buy at 50.1, rejected and re-tries at 50.3. The slippage here would be 0.2.
- **Skew Leakage**
 - Refers to the process whereby the skew of a liquidity provider that is shown to a client, propagates to a public market data source, such as an ECN.
- **Visible Spread**
 - The difference between the bid and offer prices.
- **Winner's Curse**
 - When a liquidity provider wins a trade only when their quote is mis-priced, often due to heavy aggregation.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G U T Y Z E S D C O R N Q K E X
B Y N D E Q S U **[BIBLIOGRAPHY]** R Z E J X B Y D
F H B M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F R O V

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T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G U T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[DISCLOSURE PAGE]** R Z E J X B Y D
 F H B M Y D A B Q T X U V D L O P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F R O V

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