EURONEXT FX QUANTITATIVE RESEARCH

FX Global Code/Non-Code Assessment

Let Data Drive your Decision

30 November 2022

In this paper, we compare the Spot FX liquidity on the Euronext FX and Euronext Markets Singapore platforms (together, *Euronext FX*) between liquidity providers that have signed up to the FX Global Code (*Code makers*) versus liquidity providers that have not signed up to the Code (*Non-Code makers*). Based on trades executed on Euronext FX, Code makers overall bring better quality of execution than Non-Code makers. Nevertheless, the analysis also shows that in 25% of cases, Non-Code makers improve the quality of the liquidity on Euronext FX compared to Code makers.

We first evidence that Non-Code makers account for 32% of the turnover on all crosses (see Table 2, p.5). We further show that no significant differences are observed between Code and Non-Code makers on a taker's realised spread (see Table 3, p.7) and Markouts (Table 4 and Table 5, p.9). This dispels the preconception that Non-Code makers would display more leakage and larger Markouts.

We then show that Non-Code makers have a +12% higher rejection rate than Code makers (Table 6, p.11) on all crosses.

Lastly we evidence that Non-Code makers have a +0.12 bps larger expected slippage than Code makers (see Table 8 p.17) on all crosses. However, we further clearly show that in 25% of sessions, Non-Code makers have a better expected slippage compared to Code makers (see Table 8, p.17).

These conclusions support our view that, at this time, the most efficient response to the Code / Non-Code choice is for takers on our platforms to make a data driven decision regarding the make-up of their liquidity pool. To support this choice, we encourage our takers to perform an ongoing case-by-case assessment of their makers on Euronext FX.

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CONTENTS

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1 INTRODUCTION

Main questions on Code makers addressed

In light of the recent changes to the **FX Global Code** and increasing industry adherence, Euronext FX has taken a pragmatic stance, evaluating the pros and cons of its Code makers versus its Non-Code makers.

In this paper, we will provide answers to the following questions:

- How does the liquidity brought by Non-Code makers compare to that brought by Code makers?
- Are spreads higher with Non-Code makers compared to Code makers?
- Is there more leakage when trading with Non-Code makers compared to Code makers?
- Are Non-Code makers rejecting trades more often than Code makers? And at a worst timing?
- How can we assess the benefits brought by a maker from the taker's point of view: the expected slippage?
- Are Non-Code makers worsening the taker's slippage, on average? How often in this case?

To answer these questions we will study empirically the outcomes for a taker trading in anonymous sessions. We will measure from the taker point of view the consequences of trading with a Code maker or Non-Code maker.

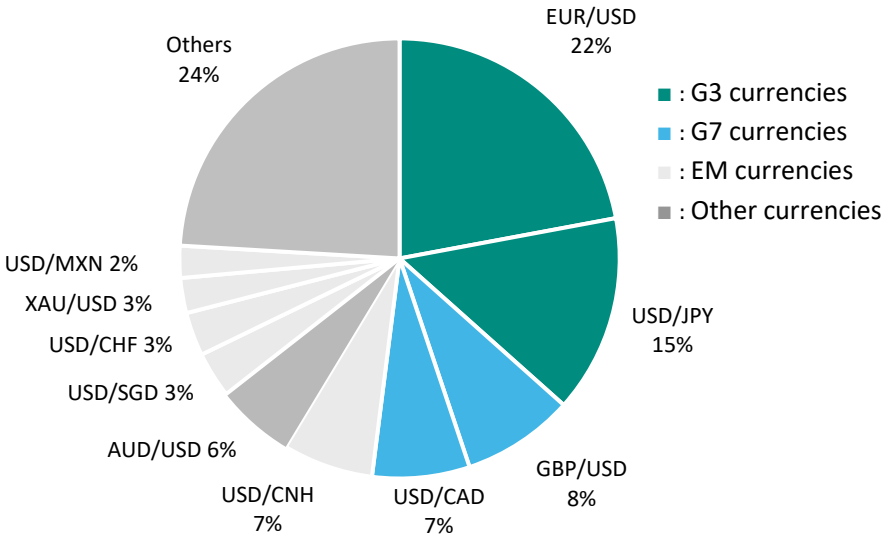
2 DATA AND UNIVERSE

2.1 TRADES UNIVERSE

Trades universe

Our dataset is constituted from filled and rejected taker requests on the Euronext FX and Euronext Market Singapore Spot FX platforms over the period of 1 June 2022 to 31 August 2022, on all currencies, as displayed in **Figure 1** and **Table 1**.

Figure 1: Global turnover by pair on Euronext FX platform



Source: Euronext FX data | All passive filled trades on 86 currency pairs
Anonymous sessions | 1 Jun. 2022 to 31 Aug. 2022

Table 1: Global turnover by group of currencies

Group name	Currencies	Number of traded pairs	$-amount (filled, bn)	Proportion of turnover
G3	EUR;USD;JPY	3	$464 bn	38%
G7	EUR;USD;JPY;CAD;GBP	10	$686 bn	57%
EM	CNH;SGD;MXN;ZAR;…	23	$244 bn	20%
All crosses		**86**	**$1211 bn**	**100%**

Source: All passive filled trades on 86 currency pairs
Anonymous sessions | 1 Jun. 2022 to 31 Aug. 2022

In this paper we have selected the largest anonymous sessions on Euronext FX. In order to have enough statistical robustness, we have used the filters described in Appendix, section A (p.20). In total, our dataset comprises US $947 billion in turnover, and over 1.53 million trades.

3 WHAT LIQUIDITY DO CODE SIGNATORIES BRING?

We display in **Table 2** below the breakdown of the turnover of anonymous liquidity provider (maker) sessions broken down by groups of currencies. For example, 4% (line 3, col. 3) of the makers' turnover on EUR/USD is made by Non-Code makers.

Table 2: Global turnover by groups of currencies

Maker types	Currency group	Non-Code	Code	All
All segments	All crosses	32%	68%	100%
	EUR/USD	4%	16%	20%
	USD/JPY	4%	8%	12%
	G3	9%	25%	34%
	G7	14%	38%	53%
	EM	8%	14%	21%

Source: All passive filled trades on 86 currency pairs
Anonymous sessions | 1 Jun. 2022 to 31 Aug. 2022

4 ARE REALISED SPREADS LARGER WITH CODE MAKERS?

4.1 DEFINITION: REALISED SPREAD

Considering a buy trade filled at time t_{Fill}, we define the realised spread as the relative difference between the trade price ($TradePrice$) and the mid-price at the time of the trade ($BBO\ MidPrice(t_{Fill})$), corresponding to the mid-price of the best ask and the best bid at the time of the trade:

For a buy trade:

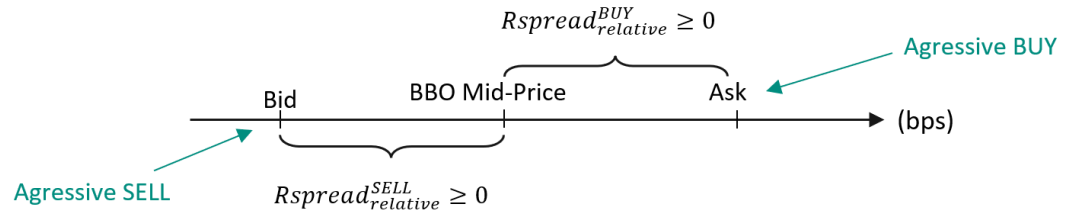
$$Rspread^{BUY}_{relative}(bps) = 10^4 \times \left[\frac{TradePrice}{BBO\ MidPrice(t_{Fill})} - 1\right]$$

For a sell trade we consider the opposite difference.

$$Rspread^{SELL}_{relative}(bps) = -10^4 \times \left[\frac{TradePrice}{BBO\ MidPrice(t_{Fill})} - 1\right]$$

Considering this definition, realised spreads should on average be positive for an aggressive trade, since bid-ask spreads are strictly positive, as illustrated below. For a taker, it is best to trade at the smallest realised spread.

Figure 2: Explicative scheme for the realised spread definition



Explicative scheme for the realised spread definition

4.2 REALISED SPREADS FOR CODE AND NON-CODE MAKERS

We display in **Table 3** the average realised spread computed on aggregated buy and sell trades across taker sessions split by Code and Non-Code makers, on different currency groups.

On all currencies, taker sessions trading with Code makers display an average realised spread of 0.70 bps (see line 2, col.2 in **Table 3**). This means that takers trade at an execution price +0.70 bps higher than the execution mid-price. When trading with Non-Code makers, the average realised spread amounts to 0.69 bps, which corresponds to only a -0.01 bps improvement. When considering a given taker session (see line 6, col.3 in **Table 3**), the average realised spread is the same between Code makers and Non-Code makers.

This shows that on average, when considering all currencies, we do not observe statistically significant differences between the realised spreads of Code makers and Non-Code makers.

Table 3: Computation results for realised spreads on buy and sell trades

Realised spread (Code and Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Code makers *(avg., bps)*	0.70	0.18	0.24	0.26	0.31	1.02
Non-Code makers *(avg., bps)*	0.69	0.20	0.22	0.25	0.31	1.01
All makers *(avg., bps)*	0.70	0.19	0.23	0.25	0.31	1.01
Realised spread changes (Code makers compared to Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Non-Code makers vs Code makers, for a given taker *(avg., bps)*	0.00	+0.02	-0.02	-0.01	+0.00	-0.02
% number of taker sessions where Non-Code makers have a lower realised spread than Code makers	51%	40%	57%	59%	48%	45%
% turnover of the sessions where Non-Code makers have a lower realised spread than Code makers	47%	40%	65%	66%	51%	36%

Source: Euronext FX Data, see section C in Appendix (p.22)

5 DO NON-CODE MAKERS LEAK MORE INFORMATION?

It is generally expected that Non-Code makers misbehave and take advantage of the information they gather from takers for their own trading. In order to assess whether or not this expectation is confirmed, we measure the Markouts following the match of a taker order to a Code maker or to a Non-Code maker.

5.1 DEFINITION: MARKOUTS AFTER 10 TRADES

On filled trades: Considering a filled buy trade that occurred at time t_{Fill}, we define the Markout after 10 trades as the relative difference between the average of BBO mid-price considered at the time of the next 10 trades (buy or sell, filled or rejected) succeeding t_{Fill}, and the BBO mid-price at t_{Fill} ($BBO\ MidPrice$ corresponding to the mid-price of the best ask and the best bid at a given time):

$$Markout^{BUY,Fill}_{next\ 10\ trades}(bps) = 10^4 \times \left[\frac{Avg_{t\in\{10\ next\ orders\ after\ t_{Fill}\}} BBO\ MidPrice(t)}{BBO\ MidPrice(t_{Fill})} - 1\right]$$

For a sell trade we consider the opposite difference:

$$Markout^{SELL,Fill}_{next\ 10\ trades}(bps) = -10^4 \times \left[\frac{Avg_{t\in\{10\ next\ trades\ after\ t_{Fill}\}} BBO\ MidPrice(t)}{BBO\ MidPrice(t_{Fill})} - 1\right]$$

On rejects: Considering a rejected buy trade that occurred at time t_{Reject}, we define the Markout after 10 trades as the relative difference between the average of BBO mid-price considered at the time of the next 10 trades (buy or sell, filled or rejected) after t_{Reject}, and the BBO mid-price at t_{Reject} ($BBO\ MidPrice$ corresponding to the mid-price of the best ask and the best bid at a given time):

$$Markout^{BUY,Reject}_{next\ 10\ trades}(bps) = 10^4 \times \left[\frac{Avg_{t\in\{10\ next\ trades\ after\ t_{Reject}\}} BBO\ MidPrice(t)}{BBO\ MidPrice\left(t_{Reject}\right)} - 1\right]$$

For a sell trade we consider the opposite difference:

$$Markout^{SELL,Reject}_{next\ 10\ trades}(bps) = -10^4 \times \left[\frac{Avg_{t\in\{10\ next\ trades\ after\ t_{Reject}\}} BBO\ MidPrice(t)}{BBO\ MidPrice\left(t_{Reject}\right)} - 1\right]$$

Considering this definition, a greater leakage should correspond to a larger $Markout_{next\ 10\ trades}$ following a trade upon fill as well as following rejects. For a standard institutional trade, a positive Markout is expected on average.

5.2 MARKOUTS FOR CODE AND NON-CODE MAKERS

We display in **Table 4** below the average Markouts computed after a fill on both buy and sell trades, on different currency groups.

Markouts on filled trades

On filled trades, considering "All pairs", taker sessions trading with Code makers display an average Markout of +0.45 bps (line 2, col.2 in **Table 4**), meaning that over the next 10 trades on Euronext FX on the same pair, the average mid-price increases by +0.45 bps after a buy trade with a Code maker (and decreases by -0.45 bps for a sell trade). When trading with Non-Code makers, the average Markout of these same taker sessions before a fill trade is +0.43 bps, which corresponds to an improvement of -0.02 bps as displayed in **Table 4** (lines 2 and 3, col.2).

This shows that on average when considering all currencies, we do not observe statistically significant differences between the Markouts of Code makers and those of Non-Code makers before a fill. Likewise, when considering a given taker session (line 6 in **Table 4**), the average Markout on a fill trade on all currencies is the same between Code makers and Non-Code makers.

Table 4: Computation results for the Markouts on filled trades

$Markout^{Fill}_{next\ 10\ trades}$ (Code and Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Code makers *(avg., bps)*	0.45	0.11	0.16	0.14	0.37	0.37
Non-Code makers *(avg., bps)*	0.43	0.17	0.23	0.23	0.23	0.71
All makers *(avg., bps)*	0.44	0.14	0.19	0.19	0.30	0.54
$Markout^{Fill}_{next\ 10\ trades}$ **changes** (Code makers compared to Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Non-Code makers vs Code makers for a given taker *(avg., bps)*	0.00	+0.06	+0.02	+0.06	-0.07	+0.35
% number of taker sessions where Non-Code makers have a lower $Markout^{Fill}_{next\ 10\ trades}$ than Code makers	46%	40%	46%	40%	52%	35%
% turnover of taker sessions where Non-Code makers have a lower $Markout^{Fill}_{next\ 10\ trades}$ than Code makers	52%	44%	42%	38%	59%	21%

Source: Euronext FX Data, see section C in Appendix (p.22)

Markouts on rejects

We then display, in **Table 5** below, the average Markouts after a reject computed on both buy and sell rejects. On "All pairs", taker sessions trading with Code makers display an average Markout on rejects of +0.46 bps. Following rejects by Non-Code makers, the average Markout of these same taker sessions before a fill trade is +0.51 bps, which corresponds to a worsening of slippage of only +0.05 bps as displayed in **Table 5** (lines 2 and 3, col.2).

Finally, when comparing for a given taker the differences in Markouts following a trade, we observe a very modest worsening in the slippage of only +0.09 bps when trading with Non-Code makers.

This shows that on average when considering all currencies, we do not observe any statistically significant large differences in Markouts when trading either with Code makers or Non-Code makers before a reject.

Table 5: Computation results for the Markouts on rejected trades

$Markout^{Reject}_{next\ 10\ trades}$ (Code and Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Code makers *(avg., bps)*	0.46	0.24	0.26	0.17	0.32	0.62
Non-Code makers *(avg., bps)*	0.51	0.13	0.18	0.28	0.31	0.61
All makers *(avg., bps)*	0.49	0.18	0.22	0.22	0.32	0.62
$Markout^{Reject}_{next\ 10\ trades}$ **changes** (Code makers compared to Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Non-Code makers vs Code makers for a given taker *(avg., bps)*	+0.09	-0.10	-0.09	+0.14	+0.01	-0.11
% number of taker sessions where Non-Code makers have a lower $Markout^{Reject}_{next\ 10\ trades}$ than Code makers	56%	66%	57%	55%	48%	52%
% turnover of taker sessions where Non-Code makers have a lower $Markout^{Reject}_{next\ 10\ trades}$ than Code makers	62%	77%	61%	65%	50%	34%

Source: Euronext FX Data, see section C in Appendix (p.22)

6 DO NON-CODE MAKERS REJECT TRADES MORE OFTEN AND AT MORE ADVERSE TIMING?

6.1 DEFINITION: REJECTION RATE

We define the rejection rates between a taker (T) and a maker (M) by the ratio between the rejected $-Amount and the total $-Amount requested by takers T to makers M (corresponding to the sum of the rejected $-Amount and the filled $-Amount):

$$Rej_{Rate}^{T,M}(\%) = 100 \times \frac{Rejected\ \$Amount(T,M)}{Rejected\ \$Amount(T,M) + Filled\ \$Amount(T,M)}$$

6.2 DEFINITION: MID-PRICE VARIATION UPON REJECTS

We define the mid-price variations for a rejected trade using the relative difference of BBO mid-price from the time of match t_{Match} to the time of the rejected trade t_{Reject}(for more information on execution and arrival times see Appendix, section B, p.21).

$$\Delta_{MidPrice,Reject}^{BUY}\ (bps) = 10^4 \times \frac{BBO\ MidPrice(t_{Reject}) - BBO\ MidPrice(t_{Match})}{BBO\ MidPrice(t_{Match})}$$

$$\Delta_{MidPrice,Reject}^{SELL}\ (bps) = -10^4 \times \frac{BBO\ MidPrice(t_{Reject}) - BBO\ MidPrice(t_{Match})}{BBO\ MidPrice(t_{Match})}$$

Compared to Markouts, which provide information on the mid-price evolution after the execution, the Mid-price variation evaluates the variation in mid during the 'last look' window, until the reject time.

With this definition, a positive mid-price variation means that a passive seller would tend to reject a trade when the price increases, meaning that rejections by makers are more likely to take place on adverse price changes for makers.

6.3 REJECTION RATES AND MID-PRICE VARIATION FOR CODE AND NON-CODE MAKERS

Rejection rates across Code and Non-Code makers

Table 6 below shows the average rejection rate across taker sessions split by Code and Non-Code makers, on different currency groups. When considering all pairs together, we observe a +12% worsening of the rejection rate when trading with Non-Code makers compared to Code makers (see line 6, col. 2). Only 14% (see line 7, col. 2) of the taker sessions display a higher fill rate with Non-Code makers rather than with Code makers. These taker sessions account for only 8% (see line 8, col.2) of turnover on all pairs.

This shows clearly that Non-Code makers have lower fill rates than Code makers and are therefore rejecting trades more often than Code makers.

Table 6: Computation results for the rejection rates

Rejection rate (Code and Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Code makers *(avg, %)*	23%	26%	25%	23%	22%	20%
Non-Code makers *(avg.,%)*	34%	42%	38%	38%	38%	36%
All makers *(avg,.%)*	28%	34%	32%	30%	30%	28%
Rejection rate changes (Code makers compared to Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Non-Code makers vs Code makers for a given taker *(avg., %)*	+12%	+15%	+13%	+15%	+15%	+15%
% number of taker sessions where Non-Code makers have a lower rejection rate than Code makers	14%	14%	13%	11%	7%	6%
% turnover of taker sessions where Non-Code makers have a lower rejection rate than Code makers	8%	13%	13%	12%	5%	1%

Source: Euronext FX Data, see section C in Appendix (p.22)

Mid price variations on rejects across Code and Non-Code makers

We now display in **Table 7** below the average mid-price variation before a reject, on different currency groups.

When considering all pairs together, we observe a +0.10 bps worsening of the mid-price variation upon reject when trading with Non-Code makers compared to Code makers (see line 6, col. 2). This shows that on average, Non-Code makers reject orders in more adverse mid-price variations than Code makers do.

Nevertheless, in 25% of the taker sessions (see line 7, col. 2), mid-price variations on rejects are less adverse with Non-Code makers than with Code makers. The turnover of these sessions accounts for 27% (see line 8, col. 2) of the total turnover on all pairs.

Table 7: Computation results for the mid-price variation before a reject

$\Delta_{MidPrice,Reject}$ (Code makers and Non-Code makers)	All pairs	EUR/ USD	USD/ JPY	G3	G7	EM
Code makers *(avg., bps)*	0.23	0.19	0.20	0.17	0.16	0.25
Non-Code makers *(avg., bps)*	0.33	0.23	0.26	0.24	0.24	0.43
All makers *(avg., bps)*	0.28	0.21	0.23	0.21	0.2	0.34
$\Delta_{MidPrice,Reject}$ changes (Code makers compared to Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Non-Code makers vs Code makers for a given taker *(avg., bps)*	+0.10	+0.04	+0.05	+0.05	+0.06	+0.18
% number of taker sessions where Non-Code makers have a lower $\Delta_{MidPrice,Reject}$ than Code makers	25%	37%	36%	32%	30%	29%
% turnover of taker sessions where Non-Code makers have a lower $\Delta_{MidPrice,Reject}$ than Code makers	27%	32%	26%	26%	28%	44%

Source: Euronext FX Data, see section C in Appendix (p.22)

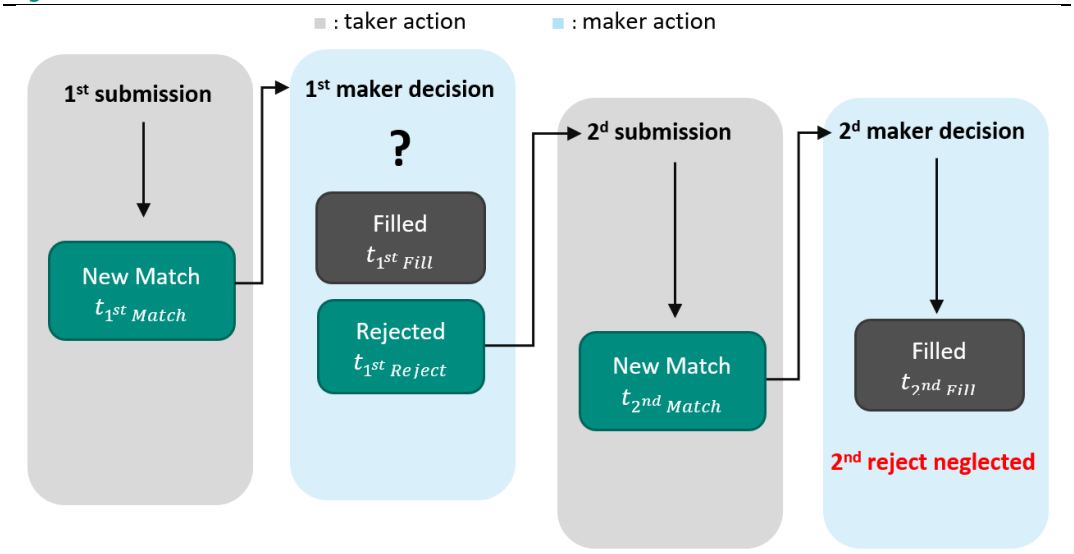
Table 11 in Appendix, section D (p.24) displays the average mid-price variation before filled trades, on different currency groups. When considering all pairs together, we observe a +0.06 bps worsening of the mid-price variation upon trade when trading with Non-Code makers compared to Code makers (see line 6, col. 2) Nevertheless, 27% (see line 7, col. 2) of the taker sessions trades with Non-Code makers display less adverse mid-price variations than those with Code makers.

7 ASSESSING THE QUALITY OF A MAKER BASED ON THE TAKER EXPECTED SLIPPAGE

7.1 THE TAKER ORDER SUBMISSION PROCESS

In the following section, we define the "expected slippage" for the taker, taking into account the rejection rates, the realised spreads at fill and the mid-price variation as defined previously. **Figure 3** illustrates the different steps in a simplified order-trade process for a taker.

Figure 3: From the taker order submission to the trade

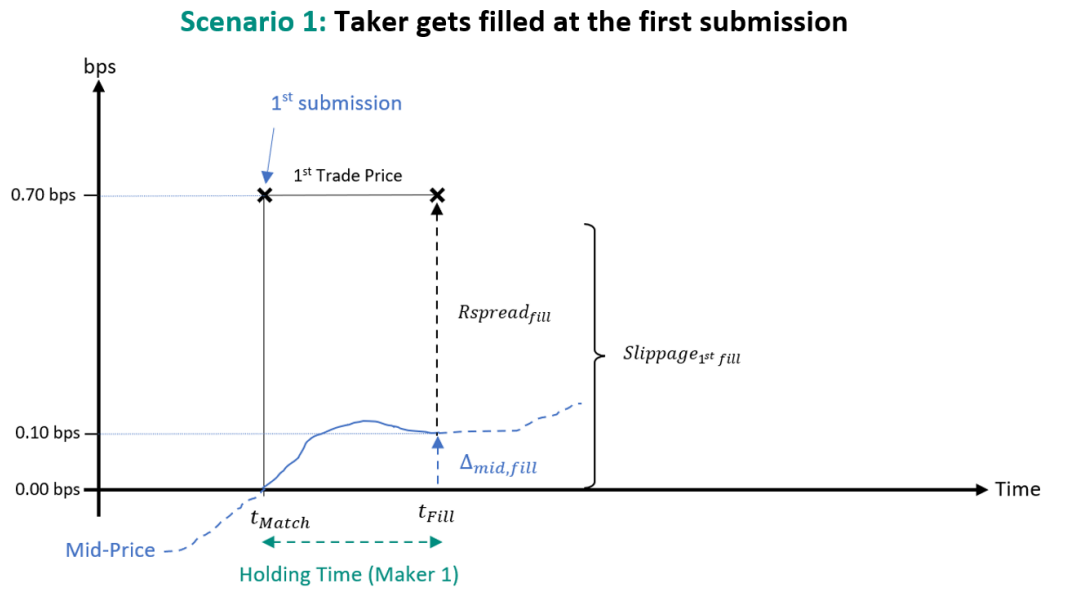


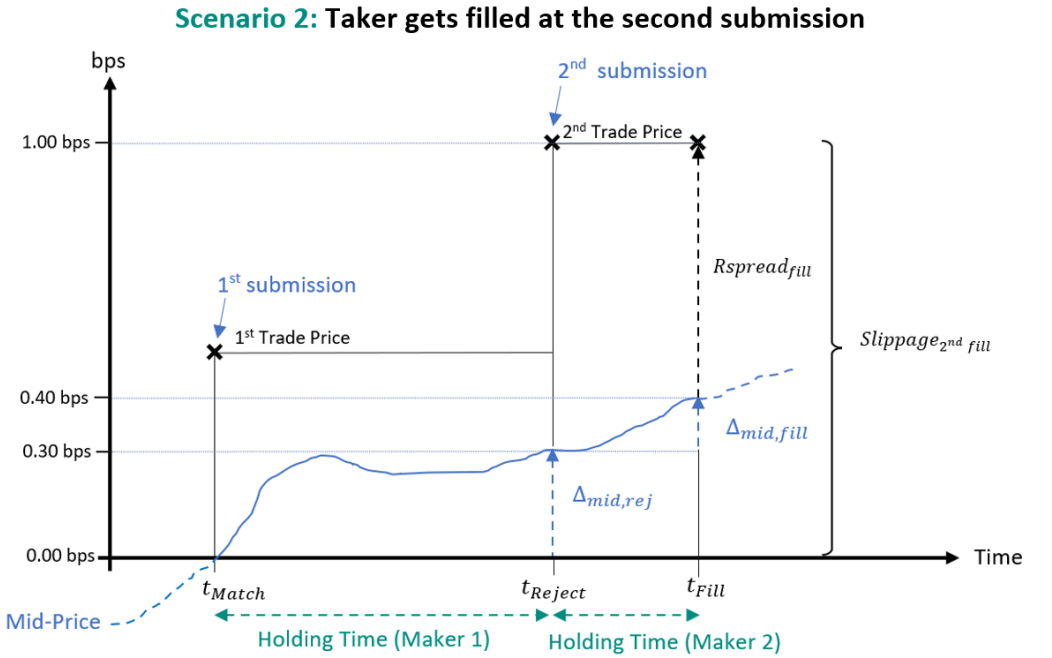
Explanatory scheme for the issues of a trade from the taker's point of view

When initially submitting an order, the taker is first matched (paired) with a maker, which can either fill or reject the order using its Last Look optionality. If the maker accepts the trade, then the trade is settled. But if the order is rejected by the first maker, the taker has to resubmit the order for a second time before that order is matched with a second maker. In our modelling, we assume that the second maker always fills the order and there is no need to resubmit the order for a third time.

Figure 4 below displays the timeline and the price changes that may occur during this process. All these parameters are later combined in order to define the slippage in the case of a fill and in the case of a reject: the realised spread, and the mid-price variation before a reject and a fill.

Figure 4: Scheme explaining issues of a trade for a taker, theoretical modelling





Explanatory scheme for the issues of a trade from the taker's point of view

7.2 COMPUTING THE EXPECTED SLIPPAGE

Slippage on filled trades at the 1st submission

For a buy trade, the slippage at first fill corresponds to the relative difference between the trade price and the arrival BBO mid-price considered at the order arrival time, that is the first submission and fill t_{Match}. (**Figure 4** upper chart)

$$Slippage_{1^{st}\,Fill}(bps) = 10^4 \times \left[\frac{TradePrice}{BBO\ MidPrice(t_{Match})} - 1\right] = Rspread_{1^{st}\,Fill} + \Delta_{MidPrice,1^{st}\,Fill}$$

Slippage on filled trades at the 2nd submission

For a buy trade, the slippage at second fill corresponds to the relative difference between the trade price and the arrival BBO mid-price considered at the first order submission (see **Figure 4** lower chart):

$$\begin{aligned} Slippage_{2^{nd}\,Fill}(bps) &= 10^4 \times \left[\frac{TradePrice}{BBO\ MidPrice(t_{Match})} - 1\right] \\ &= Rspread_{2^{nd}\,Fill} + \Delta_{MidPrice,\,2^{nd}\,Fill} + \Delta_{MidPrice,1^{st}\,Reject} \end{aligned}$$

Expected slippage computation

The expected slippage corresponds to the weighted average slippage for a trade, therefore taking into account the different issues of a submission:

$$Exp(Slippage)(bps) = 10^4 \times Expectation\left[\frac{TradePrice}{BBO\ MidPrice(t_{Match})} - 1\right]$$

This expected slippage depends on the probability of being rejected or filled:

$$\begin{aligned} &Exp(Slippage)(bps) \\ &\quad = Probability\ (Fill\ at\ 1st\ submission) \times Slippage_{1^{st}\,Fill} \\ &\quad + Probability\ (Fill\ at\ 2nd\ submission) \times\ Slippage_{2^{nd}\,Fill} \end{aligned}$$

We can estimate this probability using the rejection rate, so that

$$Exp(Slippage)(bps) = (1 - Rej_{Rate}(t,m)) \times Slippage_{1^{st}\,fill}(T) + Rej_{Rate}(t,m) \times\ Slippage_{2^{nd}\,fill}(T)$$

According to this definition, for a taker, the most favourable maker corresponds to a maker with the smallest expected slippage. The expected slippage represents the gross cost of execution.

8 ARE NON-CODE MAKERS WORSENING THE EXPECTED SLIPPAGE?

8.1 EXPECTED SLIPPAGE FOR CODE MAKERS AND NON-CODE MAKERS

We display in Table 8 below the expected slippage across taker sessions split by Code makers and Non-Code makers, on different currency groups.

The case of EUR/USD

On EUR/USD, taker sessions trading with Code makers display an average expected slippage of 0.28 bps (see line 2, col.3 in **Table 8**). This means that takers trade at an execution price +0.28 bps higher than the arrival mid-price. When trading with Non-Code makers, the average expected slippage amounts to +0.37 bps, which corresponds to +0.09 bps. Finally, when comparing for a given taker the differences in expected slippage for Code and Non-Code makers, we observe consistently a +0.09 bps worsening of the expected slippage for Non-Code makers (see line 6, col.3 in **Table 8**). Nevertheless, 16% of the overall number of taker sessions still benefit from trading with Non-Code makers compared to Code makers.

Table 8: Computation results for the expected slippage

$Exp(Slippage)$ (Code makers and Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Code makers *(avg., bps)*	0.83	0.28	0.36	0.35	0.40	1.13
Non-Code makers *(avg., bps)*	0.94	0.37	0.41	0.4	0.46	1.32
All makers *(avg., bps)*	0.89	0.33	0.38	0.38	0.43	1.22
$Exp(Slippage)$ **changes** (Code makers compared to Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Non-Code makers vs Code makers for a given taker *(avg., bps)*	+0.12	+0.09	+0.05	+0.05	+0.07	+0.15
% number of taker sessions where Non-Code makers have a lower $Exp(Slippage)$ than Code makers	25%	16%	15%	25%	25%	29%
% turnover of taker sessions where Non-Code makers have a lower $Exp(Slippage)$ than Code makers	21%	7%	11%	18%	23%	18%

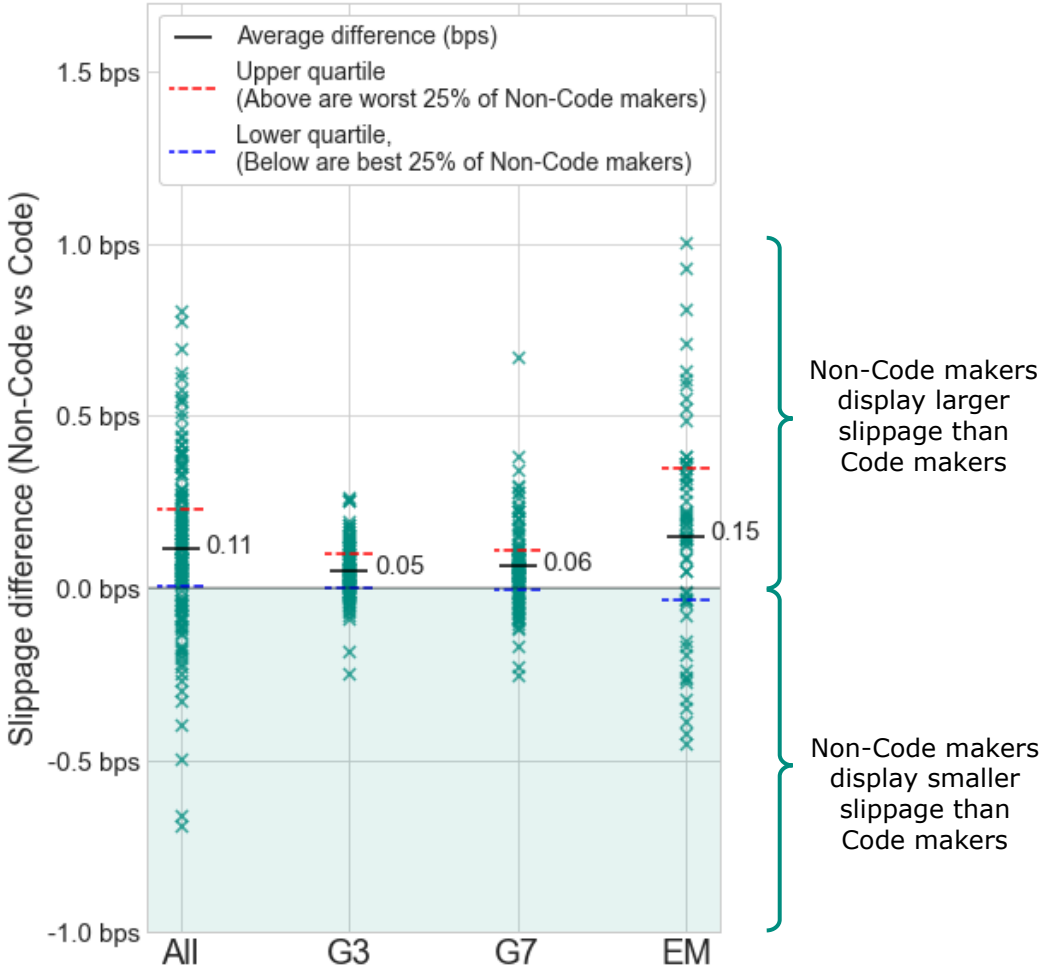
Source: Euronext FX Data, see sections C and E in Appendix (p.22 and 25)

All pairs together

When considering all pairs together, we observe a +0.11 bps worsening of the expected slippage when trading with Non-Code makers compared to Code makers (see line 2, col.3 in **Table 8**). Nevertheless, in 25% of the taker sessions (see line 7, col.2), trades with Non-Code makers display lower expected slippage than trades with Code makers. The turnover of these sessions accounts for 21% of turnover on all pairs sessions (see line 8, col.2). That is why, when dealing with Non-Code makers, a case-by-case approach should be implemented.

In **Figure 5**, we represent for each taker session the difference in expected slippage for Non-Code makers versus Code makers. We observe that in almost 25% of taker sessions, the difference in expected slippage is negative, meaning that Non-Code makers show a smaller slippage than Code makers. Hence, we show that in 25% of taker sessions, the liquidity brought by Non-Code makers provides better slippages compared to Code makers.

Figure 5: Expected slippage difference between Code and Non-Code makers for a given taker



Source: Euronext FX Data, see section C in Appendix (p.22)

9 CONCLUSION

Based on our computations on trade activity in the June to August 2022 period, we have evidenced that there is some benefit in takers consuming Non-Code liquidity. The following points have led to our decision to continue to, at present, allow Non-Code signatories to trade on our platform.

- Liquidity from Non-Code makers: When considering all pairs, 32% of liquidity is provided by Non-Code makers. On Emerging Markets pairs, Non-Code makers represent as much as 37%, while on EUR/USD they represent only 21% of the turnover.

- Spreads: On average, when considering all currencies, we do not observe statistically significant differences between the realised spreads of Code makers and those of Non-Code makers.

- Leakage: On average, when considering all currencies, we do not observe any statistically significant large differences in markouts when trading with either Code or Non-Code makers on a reject or a fill. Information leakage is not greater when trading with Non-Code makers.

- Rejections: When considering all pairs together, we observe a +12% worsening of the rejection rate when trading with Non-Code makers compared to Code makers. Likewise, we observe a +0.11 bps worsening of the mid-price variation upon reject when trading with Non-Code makers compared to Code makers. This shows that, on average, Non-Code makers reject orders in more adverse mid-price variations than Code makers do.

- Slippage: When considering all pairs together, we observe a +0.12 bps worsening of the expected slippage when trading with Non-Code makers compared to Code makers. Nevertheless, in 25% of the taker sessions, trades with Non-Code makers display lower expected slippage than those of Code makers.

Based on the findings above, Euronext FX has decided to automatically transition all anonymous Spot liquidity to pools composed of FX Global Code signatories only, with the option for clients to opt out and retain their current liquidity. This change will be effective across all centres January 1, 2023. Non-Code signatory LPs will be removed from clients' liquidity pools *unless* takers expressly request that such LPs (identified by their anonymous tag) remain. Additionally, all new sessions created for our takers will default to Code-only, unless takers instruct otherwise. We are confident that this decision will only strengthen the quality of service we provide.

We believe this new direction is in line with the preferences of our clients. Indeed, we are happy to report that more than 80% of Euronext FX's September Spot volume was transacted with Code-signatory LPs. Our goal is to provide our clients with informed choices, based on the enhanced analytical data Euronext FX provides, while promoting adherence to the best practices and principles endorsed by the FX Global Code.

APPENDIX

A. TAKER SESSIONS FILTERING

To highlight the makers' behaviour, we filtered the largest taker sessions according to the following table:

Table 9: Applied filters for taker sessions selection

Criterion	**Applied filter**
Time frame	2022.06.01 – 2022.08.31 (80 trading days)
Cross group	All crosses; EUR/USD;USD/JPY; G3;G7;EM
Session type	Taker, Anonymous
Trade type	'BUY'&'SELL' Quotes
Number of trades with Code	> 100 filled trades
Number of trades with Non-Code	> 100 filled trades
Traded $-amount	> $300m filled

Table 10: Traded $-amount and number of trades of the filtered taker sessions

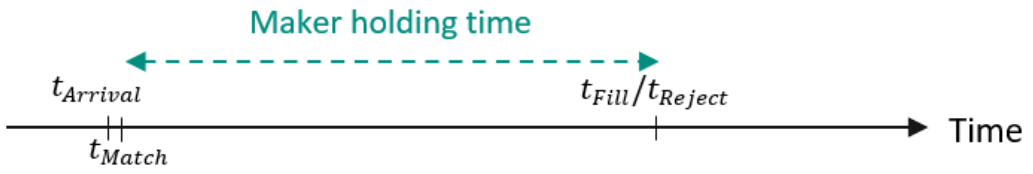
Currency group	**Traded $-amount** (filled and rejected, $bn)	**Number of trades** (filled and rejected, m)
All crosses	$947 bn	1.5 m
EUR/USD	$193 bn	0.3 m
USD/JPY	$150 bn	0.2 m
G3	$360 bn	0.5 m
G7	$537 bn	0.7 m
EM	$181 bn	0.3 m

B. DEFINITION: TIMINGS OF A TRADE

Considering an aggressive trade, three different times should be considered. These times are always given in *ms*.

1. $t_{Arrival}$, the time at which the taker submits an order on the platform.
2. t_{Match}, the time at which the taker is matched with a maker on the platform.
3. $t_{Decision}$, the time at which the maker either fills or rejects the order:
    A. If the maker rejects the order, then $t_{Decision} = t_{Fill}$.
    B. If the maker fills the order, then $t_{Decision} = t_{Reject}$.

Figure 6: Explicative scheme for the definition of different timing of a trade



Explicative scheme for the timings of a trade

As can be seen in **Figure 6** above, $t_{Decision} - t_{Arrival} \gg t_{Match} - t_{Arrival}$ leading to the hypothesis that $t_{Arrival} \approx t_{Match}$.

C. COMPUTATION METHODOLOGY

In this section, we explain the methodology we followed in order to compare the behaviour of Code and Non-Code makers for a given taker. To assess the quality of a maker, different metrics were analysed. We illustrate our method using the example of rejection rates on EUR/USD.

1ST STEP: METRIC DEFINITION

We define the rejection rates between a taker (T) and a maker (M) by the ratio between the rejected $-Amount and the total $-Amount treated between T and M (corresponding to the sum of the rejected $-Amount and the filled $-Amount):

$$Rej_{Rate}^{T,M}(\%) = 100 \times \frac{Rejected\ \$Amount(T,M)}{Rejected\ \$Amount(T,M) + Filled\ \$Amount(T,M)}$$

2ND STEP: METRIC COMPUTATION

Let T be one of the filtered taker sessions for EUR/USD. We then compute the rejection rate obtained with each of the makers they traded with on our universe of trades using the previous definition of the metric.

In our example, we thus obtain the rejection rate for each taker/maker pair.

Figure 7: Example of rejection rates computation for taker session 'T0'

Cross	Taker	Maker	Global Code	Filled $-amount	Rejected $-amount	Total $-amount	Rejection rate (%)
EUR/USD	T0	M0	Signatory	4.159506e+09	1.353873e+09	5.513379e+09	24.6
EUR/USD	T0	M17	Non-Signatory	8.472227e+07	8.429656e+07	1.690188e+08	49.9
EUR/USD	T0	M14	Signatory	2.758470e+08	7.148713e+07	3.473341e+08	20.6
EUR/USD	T0	M182	Non-Signatory	5.077000e+07	4.856936e+07	9.933936e+07	48.9

Source: Euronext FX Data

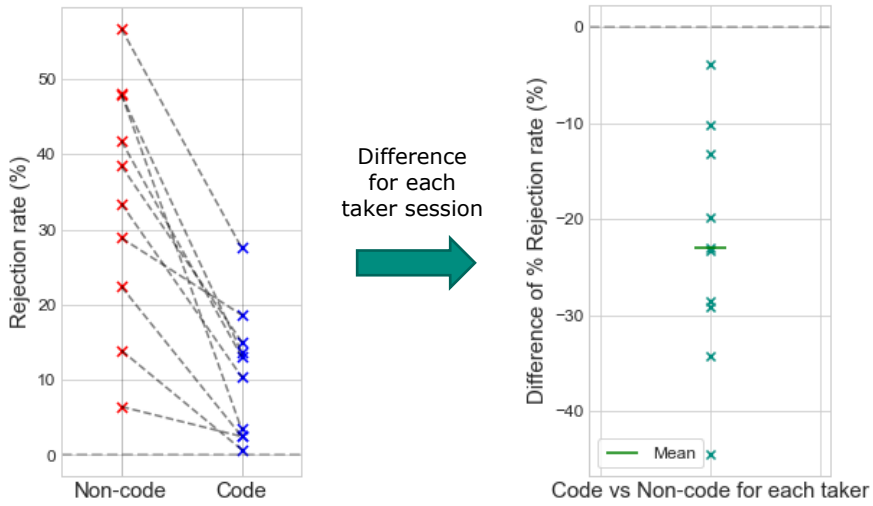
3RD STEP: CODE/NON-CODE COMPARISON

We then want to analyse the differences between Code makers and Non-Code makers. To emphasise the taker' point of view, we compute the difference between Code makers and Non-Code makers for each taker session.

In our example of rejection rates for EUR/USD, when aggregating by type of maker, we average rejection rate and sum filled, rejected and total $-amount to preserve information.

In the following **Figure 8**, each cross corresponds to a taker session and a maker type. For the example to be easier to visualise we kept only 10 taker sessions. Each dashed line connects the Code makers and Non-Code makers average metric values for a same taker session.

Figure 8: Mean of the differences between maker types for each taker sessions



Source: Euronext FX Data

To summarise, for a cross X/Y and a metric M (example: rejection rate, holding time,…), we do the following computations:

- Compute the trade-weighted mean of M for each maker/taker pair in our universe
- Compute the difference between Code and Non-Code maker using aggregation by taker session.

Since we defined relative metrics, we can then aggregate the computed metrics on different crosses (All crosses, G3, G7 and EM), or analyse the metrics for a single cross (EUR/USD, USD/JPY).

D. MID-PRICE VARIATION UPON TRADES

We now display in **Table 11** below the average mid-price variation before a filled trade, on different currency groups.

On EUR/USD, taker sessions trading with Code makers display an average mid-price variation upon trade of 0.05 bps (line 2, col.3 in **Table 11**), meaning the mid-price on EUR/USD varied by 0.05 bps during the period a Code maker held the order before filling the order. When trading with Non-Code makers, the average mid-price variation of these same taker sessions is 0.07 bps (line 3, col.3) which corresponds to a worsening of the mid-price variation by +0.02 bps.

Finally when comparing for a given taker the differences in mid-price variation upon trade for Code makers and Non-Code makers, we observe consistently a +0.02 bps worsening of the mid-price variation upon trade for Non-Code makers (line 6, col.3). Nevertheless, 37% of the overall number of taker sessions still benefit from a lower mid-price variation upon reject when trading with their Non-Code makers.

When considering all pairs together, we observe a +0.05 bps worsening of the mid-price variation upon trade when trading with Non-Code makers compared to Code makers (line 6, col.2) . Nevertheless, 27% of the taker sessions trades with Non-Code makers display lower mid-price variation upon trade than those of Code makers (line 7, col.2). The turnover of these sessions accounts for 23% of turnover on all pairs (line 8, col.2). This shows that on average, when considering all currencies, we do observe statistically significant differences between the mid-price variation of Code makers and those of Non-Code makers before a filled trade.

Table 11: Computation results for the mid-price variation before a fill

$\Delta_{MidPrice,Fill}$ (Code makers and Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Code makers *(avg., bps)*	0.06	0.05	0.06	0.05	0.05	0.07
Non-Code makers *(avg., bps)*	0.12	0.07	0.08	0.07	0.07	0.12
All makers *(avg., bps)*	0.09	0.06	0.07	0.06	0.06	0.10
$\Delta_{MidPrice,Fill}$ **changes** (Code makers compared to Non-Code makers)	**All pairs**	**EUR/ USD**	**USD/ JPY**	**G3**	**G7**	**EM**
Non-Code makers vs Code makers for a given taker *(avg., bps)*	+0.05	+0.02	+0.02	+0.02	+0.02	+0.06
% number of taker sessions where Non-Code makers have a lower $\Delta_{MidPrice,Fill}$ than Code makers	27%	46%	37%	44%	37%	27%
% turnover of taker sessions where Non-Code makers have a lower $\Delta_{MidPrice,Fill}$ than Code makers	23%	42%	29%	37%	26%	26%

Source: Euronext FX Data, see section C in Appendix (p.22)

E. DETAILED COMPUTATION FOR EXPECTED SLIPPAGE

We display in **Table 12** the intermediate steps in the calculation of the expected slippage (see Section 8, p.17). The purpose of this table is to detail the key aspects of the computation. We recall the formula for calculating the expected slippage:

$$Exp(Slippage)(bps) = Probability(Fill) \times Slippage_{1^{st}\ Fill} + Probability(Reject) \times Slippage_{2^{nd}\ Fill}$$

For example on G3 currencies, for Code makers:

1. We compute the product of $Probability(Fill)$ with $Slippage_{1^{st}\ Fill}$ for each of the filtered taker sessions:

   On average, $Probability(Fill) \times Slippage_{1^{st}\ Fill} = 0.77 \times 0.31 = 0.24\ bps$

2. We compute the product of $Probability(Reject)$ with $Slippage_{2^{nd}\ Fill}$ for each of the filtered taker sessions:

   On average, $Probability(Reject) \times Slippage_{2^{nd}\ Fill} = 0.23 \times 0.48 = 0.11\ bps$

3. We can then add the two previous results to obtain the expected slippage:

   On average, $Exp(Slippage)(bps) = 0.24 + 0.11 = 0.35\ bps$

Note that the real computation is not made on average on all taker sessions, but for each taker session. For exact methodology, see Appendix, section C (p.22).

Table 12: Computation results for the expected slippage

Maker type	Metric	All pairs	G3	G7	EM
Code makers	P_{fill} *(avg.)*	0.78	0.77	0.77	0.81
	$Slippage_{1^{st}\,Fill}$ *(avg., bps)*	0.77	0.31	0.36	1.07
	P_{rej} *(avg.)*	0.22	0.23	0.23	0.19
	$Slippage_{2^{nd}\,Fill}$ *(avg., bps)*	1.00	0.48	0.52	1.32
	$\boldsymbol{Exp(Slippage)}$ ***(avg., bps)***	0.83	0.35	0.40	1.13
Non-Code makers	P_{fill} *(avg.)*	0.67	0.62	0.63	0.65
	$Slippage_{1^{st}\,Fill}$ *(avg., bps)*	0.81	0.31	0.37	1.13
	P_{rej} *(avg.)*	0.33	0.38	0.37	0.35
	$Slippage_{2^{nd}\,Fill}$ *(avg., bps)*	1.14	0.53	0.59	1.56
	$\boldsymbol{Exp(Slippage)}$ ***(avg., bps)***	0.94	0.40	0.46	1.32
Code and Non-Code makers	P_{fill} *(avg.)*	0.72	0.69	0.70	0.73
	$Slippage_{1^{st}\,Fill}$ *(avg., bps)*	0.79	0.31	0.37	1.10
	P_{rej} *(avg.)*	0.28	0.31	0.30	0.27
	$Slippage_{2^{nd}\,Fill}$ *(avg., bps)*	1.07	0.51	0.56	1.44
	$\boldsymbol{Exp(Slippage)}$ ***(avg., bps)***	0.89	0.33	0.43	1.22

Source: Euronext FX Data, see C in Appendix (p.22)

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