

Internet Appendix for Toxic Arbitrage

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This appendix presents supplementary empirical results mentioned in our paper but not included in the main body of “Toxic Arbitrage.” It is not intended for publication. It is organized as follows:

1. In Section IA.1, we provide additional descriptive statistics for the variables used in our tests and the correlation between all variables used in our regressions.
2. In Section IA.2, we estimate eq.(25) with OLS rather than using an IV approach as in the main text.
3. In Section IA.3, we report the results for the various robustness checks mentioned in the paper (see Section 4.4).
4. In Section IA.4, we report descriptive statistics for the 2005-2011 sample as discussed in Section 4.5 in the main text and estimate equations (25) and (26) in the main text with OLS for this extended sample.

IA.1. Descriptive statistics and correlations

Table IA.1.1: Descriptive Statistics

This table presents the descriptive statistics for the variables used in our tests for each currency pair $i \in \{GU, EU, EG\}$, where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. In Panel A we present descriptive statistics for the illiquidity measures (all expressed in basis points) used in our tests: $spread_{it}$ is the average quoted bid-ask spread in currency pair i on day t ; $espread_{it}$ is the average effective spreads in currency pair i on day t ; $slope_{it}$ is the slope of the limit order book in currency pair i on day t ; $adv_selection_{it}$ is the average 1-minute price impact of trades for currency pair i on day t ; $depth_{it}$ is the average quoted depth at the best bid and ask prices for currency pair i on day t ; superscript EBS is used when these variables are measured using EBS data. Panel B presents summary statistics for control variables used in our tests: vol_{it} is the realized volatility (in percentage) of one-minute returns for currency pair i on day t ; $norders_{it}$ (in thousands) is the total number of orders (market, limit, or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ntr_{it} is the daily number of trades (in thousands) in currency pair i on day t . In panel C we report quoted spreads and depths for each currency pair just before the occurrences of toxic and non-toxic arbitrage opportunities. The sample period is from January 2, 2003 to December 30, 2004.

Panel A: Illiquidity Measures

Variable	Mean	Std.Dev.	Min	Q1	Median	Q3	Max
$spread_{GU}$	2.757	0.307	2.097	2.539	2.735	2.961	4.298
$spread_{EG}$	1.340	0.214	0.922	1.182	1.332	1.469	2.508
$spread_{EU}$	2.642	0.561	1.638	2.216	2.544	3.005	4.974
$espread_{GU}$	1.788	0.203	1.357	1.644	1.767	1.902	2.682
$espread_{EG}$	0.848	0.125	0.606	0.753	0.840	0.929	1.296
$espread_{EU}$	1.497	0.287	0.982	1.291	1.457	1.642	2.708
$slope_{GU}$	1.148	0.164	0.775	1.027	1.137	1.256	1.911
$slope_{EG}$	0.539	0.122	0.316	0.455	0.526	0.609	1.107
$slope_{EU}$	1.198	0.325	0.494	0.975	1.163	1.385	2.385
$adv_selection_{GU}$	1.163	0.171	0.765	1.050	1.141	1.259	2.059
$adv_selection_{EG}$	0.532	0.105	0.299	0.455	0.520	0.599	0.954
$adv_selection_{EU}$	1.116	0.313	0.586	0.891	1.057	1.296	2.300
$depth_{GU}$	2.661	0.210	2.112	2.518	2.633	2.781	3.809
$depth_{EG}$	3.284	0.381	1.991	3.026	3.224	3.472	5.944
$depth_{EU}$	3.049	0.382	2.100	2.801	3.000	3.259	5.471
$spread_{GU}^{EBS}$	6.408	1.341	4.064	5.675	6.093	6.802	16.15
$spread_{EG}^{EBS}$	3.447	1.467	1.690	2.486	3.153	3.834	15.62
$spread_{EU}^{EBS}$	1.139	0.045	1.051	1.105	1.137	1.163	1.336
$espread_{GU}^{EBS}$	4.169	1.657	2.425	3.149	3.781	4.553	18.21
$espread_{EG}^{EBS}$	2.090	1.316	0.913	1.331	1.741	2.348	15.91
$espread_{EU}^{EBS}$	0.995	0.057	0.900	0.959	0.984	1.019	1.330
$slope_{GU}^{EBS}$	3.124	1.229	0.896	2.248	2.891	3.717	9.035
$slope_{EG}^{EBS}$	1.566	0.972	0.419	0.928	1.307	1.868	9.647
$slope_{EU}^{EBS}$	0.297	0.040	0.205	0.268	0.295	0.322	0.441
$adv_selection_{GU}^{EBS}$	4.407	1.605	-1.500	3.396	4.283	5.280	10.89
$adv_selection_{EG}^{EBS}$	2.067	1.147	-0.458	1.395	1.819	2.462	11.19
$adv_selection_{EU}^{EBS}$	0.755	0.142	0.330	0.658	0.756	0.842	1.313
$depth_{GU}^{EBS}$	2.051	0.260	1.227	1.936	2.003	2.104	4.323
$depth_{EG}^{EBS}$	2.363	0.384	1.652	2.123	2.271	2.503	5.183
$depth_{EU}^{EBS}$	8.021	1.181	5.168	7.131	7.885	8.841	11.82

Table IA.1.1 continued.

Panel B: Control Variables

Variable	Mean	Std.Dev.	Min	Q1	Median	Q3	Max
vol_{GU}	0.458	0.111	0.097	0.388	0.440	0.505	1.277
vol_{EG}	0.405	0.089	0.162	0.344	0.398	0.460	0.843
vol_{EU}	0.595	0.173	0.227	0.481	0.567	0.686	1.511
$nrorders_{GU}$	17.90	5.975	0.576	12.89	17.79	22.56	32.22
$nrorders_{EG}$	15.02	5.698	0.307	9.560	16.29	19.59	28.93
$nrorders_{EU}$	19.36	6.671	0.470	15.01	18.34	23.12	44.08
$trsize_{GU}$	1.386	0.041	1.280	1.357	1.382	1.414	1.504
$trsize_{EG}$	1.549	0.073	1.353	1.498	1.541	1.591	1.853
$trsize_{EU}$	1.404	0.052	1.208	1.368	1.398	1.435	1.605
$nrtr_{GU}$	4.751	1.465	0.175	3.700	4.559	5.693	9.611
$nrtr_{EG}$	2.876	0.771	0.091	2.325	2.793	3.329	6.329
$nrtr_{EU}$	2.399	0.680	0.101	1.878	2.396	2.878	4.103
Obs.	483						

Panel C: Quoted Spread and Quoted Depth just before Toxic and Non-toxic Arbitrage Opportunities

	<i>Toxic</i>		<i>Non-toxic</i>		t-stat
	Mean	Std.Dev.	Mean	Std.Dev.	
$depth_{GU}$	3.056	0.942	2.936	1.519	1.48
$depth_{EG}$	3.232	0.792	3.277	0.853	-0.85
$depth_{EU}$	2.491	0.316	2.534	0.484	-1.63
$spread_{GU}$	2.777	0.539	2.676	0.573	2.82
$spread_{EG}$	1.290	0.259	1.265	0.319	1.34
$spread_{EU}$	3.096	0.924	2.804	0.966	4.80

Table IA.1.2: Correlations

This table presents correlations between the daily realizations of the variables used in our tests. Indexes *GU*, *EU*, and *EG* refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $duration_t^{all}$ denotes the average duration in seconds of toxic arbitrage opportunities on day t ; $duration_t^{tox}$ denotes the average duration in seconds of toxic arbitrage opportunities on day t ; α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; π_t^{tox} (resp., π_t^{nontox}) is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic (non-toxic) arbitrage opportunities on day t ; φ_t is the number of toxic (resp., non-toxic) arbitrage opportunities on day t divided by the number of arbitrage opportunities on that day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); $spread_{it}$ is the average quoted bid-ask spread (in basis points) in currency pair i on day t ; $espread_{it}$ is the average effective spreads (in basis points) in currency pair i on day t ; $slope_{it}$ is the average slope of the limit order book in currency pair i on day t ; adv_sel_{it} is a the price average 1-minute price impact of trades on day t for currency pair i . The last line reports the correlation between each illiquidity measure on Reuters for currency pair i and its counterpart on EBS. The sample period is from January 2, 2003 to December 30, 2004. Values with ***, ** and * are significant at 1%, 5% and 10% level respectively.

	$duration^{all}$	φ	α	σ^{tox}	$spread_{GU}$	$spread_{EG}$	$spread_{EU}$	$espread_{GU}$	$espread_{EG}$	$espread_{EU}$	$slope_{GU}$	$slope_{EG}$	$slope_{EU}$	adv_sel_{GU}	adv_sel_{EG}	adv_sel_{EU}	π^{nontox}
π^{tox}	0.18***	-0.10**	-0.14***	-0.06	0.02***	0.09**	-0.05*	-0.08*	0.02	-0.01	0.04	0.09*	-0.01	-0.09***	0.01	-0.01	0.10**
$duration^{all}$	1	-0.34***	0.04	0.25***	0.17***	0.45***	-0.03	0.06	0.38***	0.15**	0.28***	0.48***	-0.08***	0.04	0.35***	0.03	-0.04
φ		1	0.27***	0.37***	0.48***	0.23***	0.49***	0.53***	0.28***	0.46***	0.39***	0.18***	0.55***	0.49***	0.28***	0.48***	-0.23***
α			1	0.54***	0.49***	0.59***	0.27***	0.55***	0.66***	0.39***	0.48***	0.52***	0.33***	0.51***	0.61***	0.41***	-0.42***
σ^{tox}				1	0.67***	0.68***	0.63***	0.75***	0.75***	0.73***	0.64***	0.64***	0.58***	0.64***	0.71***	0.61***	-0.36***
$spread_{GU}$					1	0.66***	0.63***	0.93***	0.68***	0.67***	0.95***	0.58***	0.66***	0.86***	0.64***	0.62***	-0.36***
$spread_{EG}$						1	0.41***	0.60***	0.95***	0.56***	0.68***	0.96***	0.41***	0.55***	0.89***	0.50***	-0.37***
$spread_{EU}$							1	0.68***	0.44***	0.89***	0.58***	0.38***	0.93***	0.62***	0.44***	0.86***	-0.33***
$espread_{GU}$								1	0.68***	0.73***	0.85***	0.52***	0.69***	0.89***	0.65***	0.67***	-0.39***
$espread_{EG}$									1	0.61***	0.69***	0.90***	0.43***	0.61***	0.93***	0.53***	-0.39***
$espread_{EU}$										1	0.63***	0.53***	0.83***	0.66***	0.60***	0.91***	-0.37***
$slope_{GU}$											1	0.64***	0.58***	0.81***	0.66***	0.58***	-0.33***
$slope_{EG}$												1	0.36***	0.48***	0.85***	0.46***	-0.34***
$slope_{EU}$													1	0.64***	0.42***	0.84***	-0.35***
adv_sel_{GU}														1	0.57***	0.63***	-0.34***
adv_sel_{EG}															1	0.53***	-0.38***
adv_sel_{EU}																1	-0.37***
$illiq_{EBS}$					0.32***	0.55***	0.71***	0.32***	0.53***	0.60***	0.16***	0.29***	0.80***	0.20***	0.34***	0.26***	

IA.2. OLS estimation

Table IA.2.1: OLS Regression

This table reports OLS estimates of the following equation: $illiq_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2\varphi_t + b_3\alpha_t + b_4\sigma_t^{tox} + b_5vol_{it} + b_6trsize_{it} + b_7nrorders_{it} + b_8ted_t + b_9illiq_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $illiq_{it}$ is one of our four proxies for illiquidity for currency i on day t ($spread_{it}$, $espread_{it}$, $slope_{it}$, and $adv_selection_{it}$). Superscript EBS is used for measures of these variables computed using EBS data. φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . Other control variables are: α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i on day t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ted_t is the TED spread on day t , i.e., the difference between the LIBOR and the T-Bill rate on day t . We include a currency pair fixed effect (ω_i), a monthly fixed effect ($\xi_{t,m}$) and a time trend (coefficients b_0). t-statistics in parenthesis are calculated using robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

	<i>spread</i>	<i>espread</i>	<i>slope</i>	<i>adv_selection</i>
π	0.264 (1.78)	0.133 (1.81)	0.238 (2.83)	0.170 (2.23)
φ	0.934 (7.04)	0.435 (6.36)	0.593 (7.47)	0.437 (5.60)
α	3.863 (5.56)	2.012 (5.68)	2.543 (5.92)	2.659 (6.28)
σ^{tox}	0.107 (4.02)	0.113 (7.38)	0.025 (1.59)	0.056 (3.48)
<i>vol</i>	1.431 (9.45)	0.753 (9.01)	0.864 (8.72)	0.754 (8.30)
<i>trsize</i>	-0.299 (-2.82)	-0.131 (-2.42)	-0.379 (-5.85)	-0.199 (-3.17)
<i>nrorders</i>	-0.043 (-21.5)	-0.016 (-14.2)	-0.024 (-20.5)	-0.016 (-12.2)
<i>ted</i>	0.111 (0.59)	0.105 (1.13)	-0.075 (-0.64)	0.087 (0.79)
$illiq^{EBS}$	0.018 (3.83)	0.005 (2.11)	0.006 (1.86)	0.002 (0.57)
Adj. R^2	91.3%	93.1%	87.5%	84.7%
Obs.	1,449	1,449	1,449	1,449
Currency FE	YES	YES	YES	YES
Month FE	YES	YES	YES	YES

IA.3. Robustness checks

Table IA.3.1: Hourly Data Regressions

Panel A of this table reports estimates of the following equation: $illiq_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2\varphi_t + b_3\alpha_t + b_4\sigma_t^{tox} + b_5vol_{it} + b_6trsize_{it} + b_7nrorders_{it} + b_8ted_t + b_9illiq_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $illiq_{it}$ (resp., $illiq_{it}^{EBS}$) is one of our four proxies for illiquidity for currency i in hour t ($spread_{it}$, $espread_{it}$, $slope_{it}$, and $adv_selection_{it}$) on Reuters D-3000 (resp., EBS). φ_t is the number of toxic arbitrage opportunities in hour t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities in hour t that terminate with a trade divided by the total number of toxic arbitrage opportunities in hour t . We instrument π_t^{tox} with the introduction of AutoQuote on Reuters D-3000 (see the text). The first stage regression is: $\pi_t^{tox} = \omega_i + \xi_{t,m} + a_0t + a_1AD_t + a_2\varphi_t + a_3\alpha_t + a_4\sigma_t^{tox} + a_5vol_{it} + a_6trsize_{it} + a_7nrorders_{it} + a_8illiq_{it}^{EBS} + a_9ted_t + u_{it}$, where AD_t is a dummy variable equal to one after July 2003 and zero before. Other control variables are: α_t is the number of all arbitrage opportunities in hour t divided by the total number of trades this hour; σ_t^{tox} is the average size of toxic arbitrage opportunities in hour t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i in hour t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i in hour t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ted_t is the TED spread in hour t , i.e., the difference between the LIBOR and the T-Bill rate in hour t . Panel B presents estimates of the following regression: $\log(duration_t) = h_i + \xi_{t,m} + k_0trend + k_1AD_t + k_2\varphi_t + k_3\alpha_t + k_4\sigma_t^{tox} + k_5vol_{it} + k_6trsize_{it} + k_7nrorders_{it} + k_8ted_t + k_9spread_t^{EBS} + u_{it}$, where $duration_t$ is the average duration of toxic arbitrage opportunities (*Toxic* column) in hour t or any (both toxic and non-toxic) arbitrage opportunity (*All* column). In all regressions we include currency fixed effects, monthly fixed effects and a trend. All t-statistics in parenthesis are calculated based on robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

Table IA.3.1 continued.

Panel A: Illiquidity Regressions

	<i>spread</i>		<i>espread</i>		<i>slope</i>		<i>adv_selection</i>	
	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.044 (6.23)		0.044 (6.17)		0.046 (6.36)		0.044 (6.17)	
π^{tox}		5.439 (5.71)		1.967 (4.58)		3.265 (6.02)		1.781 (3.98)
φ	-0.036 (-2.33)	0.373 (3.94)	-0.041 (-2.59)	0.102 (2.24)	-0.043 (-2.68)	0.241 (4.24)	-0.041 (-2.59)	0.098 (2.28)
α	-0.445 (-6.18)	3.242 (4.96)	-0.459 (-6.28)	0.728 (2.08)	-0.465 (-6.20)	2.141 (5.70)	-0.458 (-6.28)	1.142 (3.08)
σ^{tox}	0.001 (0.46)	0.129 (4.12)	0.002 (0.59)	0.123 (4.49)	-0.001 (-0.01)	0.036 (3.20)	0.002 (0.61)	0.074 (4.30)
<i>vol</i>	0.040 (1.34)	4.933 (12.9)	0.042 (1.37)	3.620 (13.8)	0.050 (1.64)	2.432 (12.6)	0.041 (1.32)	4.103 (13.5)
<i>trsize</i>	-0.020 (-1.19)	-0.004 (-0.04)	-0.021 (-1.26)	0.035 (0.74)	-0.025 (-1.47)	-0.184 (-2.97)	-0.021 (-1.27)	-0.018 (-0.38)
<i>nrorders</i>	-0.014 (-5.10)	-0.296 (-12.7)	-0.013 (-4.95)	-0.178 (-12.6)	-0.013 (-4.94)	-0.141 (-11.3)	-0.013 (-4.97)	-0.169 (-11.8)
<i>ted</i>	-0.051 (-0.87)	0.514 (1.46)	-0.044 (-0.75)	0.341 (2.20)	-0.066 (-1.09)	0.171 (0.81)	-0.044 (-0.74)	0.268 (1.69)
<i>illiq</i> ^{EBS}	0.001 (1.04)	-0.001 (-0.32)	0.001 (0.34)	-0.001 (-0.17)	0.001 (0.66)	0.001 (0.06)	0.0005 (0.95)	-0.001 (-0.63)
Adj. R^2	2.5%	30.8%	2.5%	39.9%	2.6%	33.0%	2.5%	27.7%
$F - stats$	38.8		38.0		40.5		38.1	
Obs.		10,293		10,293		10,293		10,293
Currency FE		YES		YES		YES		YES
Month FE		YES		YES		YES		YES

Table IA.3.1 continued.*Panel B: Duration regressions*

	<i>Toxic</i>	<i>All</i>
<i>AD</i>	-0.153 (-10.1)	-0.144 (-12.7)
φ	-0.058 (-1.81)	-0.125 (-5.19)
α	1.205 (6.67)	0.293 (1.97)
σ	0.030 (3.07)	0.042 (5.19)
<i>vol</i>	-0.407 (-4.45)	-0.427 (-5.54)
<i>trsize</i>	0.158 (4.37)	0.105 (3.85)
<i>nrorders</i>	-0.169 (-24.6)	-0.189 (-35.9)
<i>ted</i>	0.550 (4.35)	0.325 (3.44)
<i>spread</i> ^{<i>EBS</i>}	-0.002 (-1.48)	-0.002 (-1.77)
Adj. R^2	31.7%	48.7%
Obs.	10,293	10,293
Currency FE	YES	YES
Month FE	YES	YES

Table IA.3.2: Alternative Proxies for Funding Liquidity

We estimate eq.(25) (Panels A,B,C) and eq.(26) (Panel D) in our paper with three different measures of daily funding costs for intermediaries (denoted generically $fundliq_t$), namely : (i) $drepo_t$, the aggregate primary dealer repo positions compiled by the Federal Reserve Bank of New York, (ii) $cptbdiff_t$ the difference between the 3-month commercial paper rate and 3-month T-bill rate and (iii) $HPWliq_t$, a funding cost measure constructed by Hu et al. (2013). In Panels A, B, C, we report estimates of the following equation: $illiq_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2\varphi_t + b_3\alpha_t + b_4\sigma_t^{tox} + b_5vol_{it} + b_6trsize_{it} + b_7nrorders_{it} + b_8fundliq_t + b_9illiq_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $illiq_{it}$ (resp., $illiq_{it}^{EBS}$) is one of our four proxies for illiquidity for currency i in day t ($spread_{it}$, $espread_{it}$, $slope_{it}$, and $adv_selection_{it}$) on Reuters D-3000 (resp., EBS). φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities in day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . We instrument π_t^{tox} with the introduction of AutoQuote on Reuters D-3000 (see the text). The first stage regression is: $\pi_t^{tox} = \omega_i + \xi_{t,m} + a_0t + a_1AD_t + a_2\varphi_t + a_3\alpha_t + a_4\sigma_t^{tox} + a_5vol_{it} + a_6trsize_{it} + a_7nrorders_{it} + a_8fundliq_t + a_9illiq_{it}^{EBS} + u_{it}$, where AD_t is a dummy variable equal to one after July 2003 and zero before. Other control variables are: α_t is the number of all arbitrage opportunities in day t divided by the total number of trades this day; σ_t^{tox} is the average size of toxic arbitrage opportunities in day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i in hour t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; Panel E presents estimates of the following regression $\log(duration_t) = h_i + \xi_{t,m} + k_0t + k_1AD_t + k_2\varphi_t + k_3\alpha_t + k_4\sigma_t^{tox} + k_5vol_{it} + k_6trsize_{it} + k_7nrorders_{it} + k_8fundliq_t + k_9spread_t^{EBS} + u_{it}$, where $duration_t$ is the average duration of toxic arbitrage opportunities (*Toxic* column) on day t or any (both toxic and non-toxic) arbitrage opportunity (*All* column). In all regressions we include currency fixed effects, monthly fixed effects and a trend. t-statistics in parenthesis are calculated based on robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

Panel A: Quoted Spread (spread)

	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.039 (5.73)		0.037 (5.29)		0.041 (6.09)	
π^{tox}		6.039 (4.78)		5.778 (4.41)		5.865 (4.92)
φ	-0.048 (-1.27)	0.867 (3.63)	-0.046 (-1.21)	0.839 (3.58)	-0.057 (-1.50)	0.885 (3.76)
α	-0.707 (-5.09)	7.930 (5.68)	-0.671 (-4.92)	7.686 (5.66)	-0.664 (-4.88)	7.717 (5.81)
σ^{tox}	-0.002 (-0.38)	0.126 (3.37)	-0.002 (-0.43)	0.126 (3.43)	-0.002 (-0.39)	0.126 (3.40)
<i>vol</i>	-0.008 (-0.46)	1.416 (7.53)	-0.006 (-0.34)	1.404 (7.63)	-0.007 (-0.40)	1.414 (7.56)
<i>trsize</i>	-0.017 (-0.52)	-0.079 (-0.35)	-0.024 (-0.72)	-0.063 (-0.28)	-0.025 (-0.74)	-0.067 (-0.30)
<i>nrorders</i>	-0.002 (-3.58)	-0.034 (-9.44)	-0.002 (-3.48)	-0.035 (-9.81)	-0.002 (-3.60)	-0.034 (-9.84)
$illiq^{EBS}$	0.002 (1.23)	0.012 (1.44)	0.002 (1.77)	0.013 (1.51)	0.003 (2.04)	0.01 (1.21)
<i>cptbdiff</i>	-0.077 (-2.49)	0.166 (0.71)				
<i>HPWliq</i>			0.001 (0.04)	0.046 (1.29)		
<i>drepo</i>					-0.188 (-3.07)	0.515 (1.12)
Adj. R^2	9.7%	72.3%	9.3%	74.0%	9.9%	73.4%
$F - stats$	32.9		28.0		37.1	
Obs.		1,449		1,449		1,449
Currency FE		YES		YES		YES
Month FE		YES		YES		YES

Table IA.3.2 continued.

Panel B: Effective Spread (espread)

	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.040 (5.91)		0.038 (5.49)		0.042 (6.32)	
π^{tox}		2.156 (4.15)		1.949 (3.71)		2.112 (4.25)
φ	-0.049 (-1.29)	0.390 (3.96)	-0.047 (-1.24)	0.377 (3.95)	-0.058 (-1.52)	0.391 (3.99)
α	-0.720 (-5.23)	3.415 (5.71)	-0.688 (-5.09)	3.304 (5.82)	-0.680 (-5.03)	3.411 (5.91)
σ^{tox}	-0.002 (-0.45)	0.122 (6.63)	-0.002 (-0.51)	0.121 (6.79)	-0.002 (-0.48)	0.122 (6.65)
<i>vol</i>	-0.007 (-0.42)	0.741 (8.05)	-0.005 (-0.31)	0.739 (8.20)	-0.006 (-0.35)	0.743 (8.09)
<i>trsize</i>	-0.023 (-0.68)	-0.028 (-0.31)	-0.029 (-0.88)	-0.036 (-0.43)	-0.030 (-0.90)	-0.035 (-0.39)
<i>nrorders</i>	-0.002 (-3.60)	-0.013 (-8.58)	-0.002 (-3.52)	-0.013 (-9.23)	-0.002 (-3.64)	-0.013 (-8.79)
<i>illiq^{EBS}</i>	0.003 (3.14)	-0.001 (-0.28)	0.004 (3.77)	0.001 (0.29)	0.004 (4.04)	-0.001 (-0.08)
<i>cptbdiff</i>	-0.067 (-2.17)	-0.058 (-0.68)				
<i>HPWliq</i>			0.001 (0.19)	0.023 (1.58)		
<i>drepo</i>					-0.189 (-3.11)	0.019 (0.10)
Adj. R^2	10.0%	86.5%	9.7%	87.8%	10.2%	86.8%
$F - stats$	35.0		30.2		40.0	
Obs.		1,449		1,449		1,449
Currency FE		YES		YES		YES
Month FE		YES		YES		YES

Panel C: Slope (slope)

	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.038 (5.60)		0.035 (5.12)		0.039 (5.84)	
π^{tox}		4.487 (5.05)		4.389 (4.63)		4.457 (5.18)
φ	-0.050 (-1.30)	0.576 (3.42)	-0.045 (-1.17)	0.552 (3.30)	-0.055 (-1.44)	0.585 (3.48)
α	-0.753 (-5.40)	5.823 (5.70)	-0.689 (-5.02)	5.594 (5.62)	-0.677 (-4.95)	5.593 (5.77)
σ^{tox}	-0.002 (-0.41)	0.040 (1.63)	-0.002 (-0.49)	0.041 (1.66)	-0.002 (-0.46)	0.041 (1.66)
<i>vol</i>	-0.004 (-0.25)	0.831 (6.58)	-0.002 (-0.10)	0.820 (6.59)	-0.003 (-0.15)	0.826 (6.52)
<i>trsize</i>	-0.018 (-0.55)	-0.226 (-1.42)	-0.026 (-0.79)	-0.200 (-1.27)	-0.026 (-0.79)	-0.205 (-1.28)
<i>nrorders</i>	-0.002 (-3.59)	-0.018 (-7.24)	-0.002 (-3.50)	-0.018 (-7.38)	-0.002 (-3.62)	-0.018 (-7.37)
<i>illiq^{EBS}</i>	0.002 (1.18)	-0.001 (-0.06)	0.002 (1.28)	-0.001 (-0.05)	0.002 (1.29)	-0.001 (-0.13)
<i>cptbdiff</i>	-0.102 (-3.33)	0.288 (1.75)				
<i>HPWliq</i>			-0.001 (-0.18)	0.034 (1.38)		
<i>drepo</i>					-0.179 (-2.95)	0.412 (1.29)
Adj. R^2	10.2%	46.0%	9.5%	47.8%	10.0%	46.5%
$F - stats$	31.4		26.2		34.1	
Obs.		1,449		1,449		1,449
Currency FE		YES		YES		YES
Month FE		YES		YES		YES

Table IA.3.2 continued.

Panel D: Adverse Selection ($adv_{selection}$)

	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.038 (5.67)		0.036 (5.21)		0.039 (5.92)	
π^{tox}		2.190 (3.69)		1.889 (3.21)		2.132 (3.68)
φ	-0.047 (-1.24)	0.426 (4.13)	-0.043 (-1.13)	0.409 (4.22)	-0.054 (-1.41)	0.427 (4.17)
α	-0.723 (-5.22)	4.025 (5.77)	-0.677 (-4.98)	3.879 (5.95)	-0.665 (-4.91)	4.017 (5.96)
σ^{tox}	-0.001 (-0.28)	0.062 (3.38)	-0.001 (-0.32)	0.061 (3.46)	-0.001 (-0.29)	0.061 (3.39)
<i>vol</i>	-0.011 (-0.63)	0.759 (7.75)	-0.008 (-0.48)	0.756 (7.91)	-0.009 (-0.53)	0.761 (7.79)
<i>trsize</i>	-0.019 (-0.57)	-0.114 (-1.22)	-0.026 (-0.77)	-0.120 (-1.37)	-0.026 (-0.77)	-0.120 (-1.29)
<i>nrorders</i>	-0.002 (-3.60)	-0.012 (-7.39)	-0.002 (-3.49)	-0.013 (-8.13)	-0.002 (-3.60)	-0.012 (-7.56)
<i>illiq^{EBS}</i>	0.003 (2.82)	-0.006 (-1.44)	0.004 (2.90)	-0.005 (-1.36)	0.004 (2.96)	-0.006 (-1.38)
<i>cptbdiff</i>	0.006 (0.70)	-0.124 (-3.07)				
<i>HPWLiq.</i>			-0.001 (-0.28)	0.028 (1.89)		
<i>drepo</i>					-0.181 (-2.99)	0.019 (0.09)
Adj. R^2	10.2%	46.0%	9.5%	47.8%	10.0%	46.5%
<i>F</i> – stats	32.1		27.1		35.1	
Obs.		1,449		1,449		1,449
Currency FE		YES		YES		YES
Month FE		YES		YES		YES

Panel E: Durations

	<i>Toxic</i>	<i>All</i>	<i>Toxic</i>	<i>All</i>	<i>Toxic</i>	<i>All</i>
<i>AD</i>	-0.070 (-3.62)	-0.075 (-4.54)	-0.074 (-4.05)	-0.077 (-4.84)	-0.064 (-3.38)	-0.071 (-4.28)
φ	-0.934 (-7.90)	-0.867 (-8.81)	-0.948 (-8.09)	-0.885 (-9.08)	-0.954 (-8.06)	-0.874 (-8.79)
α	-0.007 (-0.02)	-0.485 (-1.24)	-0.187 (-0.46)	-0.746 (-1.97)	0.012 (0.03)	-0.525 (-1.39)
σ^{tox}	0.101 (6.29)	0.124 (8.77)	0.101 (6.30)	0.123 (8.91)	0.101 (6.32)	0.123 (8.66)
<i>vol</i>	-0.216 (-3.37)	-0.234 (-4.14)	-0.225 (-3.49)	-0.246 (-4.33)	-0.218 (-3.38)	-0.235 (-4.15)
<i>trsize</i>	0.148 (1.48)	0.082 (0.88)	0.157 (1.60)	0.097 (1.07)	0.146 (1.48)	0.086 (0.94)
<i>nrorders</i>	-0.023 (-16.4)	-0.024 (-18.5)	-0.023 (-15.5)	-0.023 (-17.5)	-0.023 (-16.2)	-0.024 (-18.1)
<i>spread^{EBS}</i>	0.004 (0.93)	0.006 (1.57)	0.005 (1.34)	0.007 (1.90)	0.004 (1.13)	0.006 (1.50)
<i>cptbdiff</i>	-0.041 (-1.35)	-0.050 (-1.97)				
<i>HPWLiq.</i>			0.048 (3.31)	0.056 (4.38)		
<i>drepo</i>					-0.339 (-1.58)	-0.101 (-0.57)
Adj. R^2	58.3%	67.2%	58.7%	67.6%	58.4%	67.2%
Obs	1,449	1,449	1,449	1,449	1,449	1,449
Month FE	YES	YES	YES	YES	YES	YES

Table IA.3.3: Quoted Depth as a Measure of Liquidity

This table reports estimates of the following equation: $depth_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2\varphi_t + b_3\alpha_t + b_4\sigma_t^{tox} + b_5vol_{it} + b_6trsize_{it} + b_7nrorders_{it} + b_8ted_t + b_9depth_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively and $depth_{it}$ is the average quoted depth of currency i on day t . φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . We instrument π_t^{tox} with the introduction of AutoQuote on Reuters D-3000 (see the text). The first stage regression is: $\pi_t^{tox} = \omega_i + \xi_{t,m} + a_0t + a_1AD_t + a_2\varphi_t + a_3\alpha_t + a_4\sigma_t^{tox} + a_5vol_{it} + a_6trsize_{it} + a_7nrorders_{it} + a_8depth_{it}^{EBS} + a_9ted_t + u_{it}$, where AD_t is a dummy variable equal to one after July 2003 and zero before. Other control variables are: α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i on day t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ted_t is the TED spread on day t , i.e., the difference between the LIBOR and the T-Bill rate on day t ; $depth_{it}^{EBS}$ is the average quoted depth for currency i on day t on EBS. In all regressions we include a currency pair fixed effect (ω_i), a monthly fixed effect ($\xi_{t,m}$) and a time trend (coefficients b_0 and a_0). t-statistics in parenthesis are calculated using robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

	1 st stage	2 nd stage
<i>AD</i>	0.031 (4.40)	
π^{tox}		-8.128 (-3.97)
φ	-0.047 (-1.23)	-0.696 (-2.25)
α	-0.682 (-5.01)	-7.997 (-4.23)
σ^{tox}	-0.001 (-0.17)	-0.030 (-0.75)
<i>vol</i>	-0.013 (-0.73)	-0.342 (-1.71)
<i>trsize</i>	-0.012 (-0.36)	3.127 (9.03)
<i>nrorders</i>	-0.001 (-3.01)	0.004 (0.96)
<i>ted</i>	-0.109 (-2.17)	-0.798 (-1.54)
<i>illiq^{EBS}</i>	-0.004 (-1.28)	0.084 (2.94)
Adj. R^2	9.7%	68.2%
<i>F – stats</i>	19.4	
Obs.	1,449	1,449
Currency FE		YES
Month FE		YES

Table IA.3.4: Adverse Selection Costs Measured with 5-minutes Price Impacts

This table reports estimates of the following equation: $adv_selection_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2\varphi_t + b_3\alpha_t + b_4\sigma_t^{tox} + b_5vol_{it} + b_6trsize_{it} + b_7nrorders_{it} + b_8ted_t + b_9adv_selection_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively and $adv_selection_{it}$ is the average 5-minutes price impact of trades for currency i on day t . φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . We instrument π_t^{tox} with the introduction of AutoQuote on Reuters D-3000 (see the text). The first stage regression is: $\pi_t^{tox} = \omega_i + \xi_{t,m} + a_0t + a_1AD_t + a_2\varphi_t + a_3\alpha_t + a_4\sigma_t^{tox} + a_5vol_{it} + a_6trsize_{it} + a_7nrorders_{it} + a_8ted_t + a_9adv_selection_{it}^{EBS} + u_{it}$, where AD_t is a dummy variable equal to one after July 2003 and zero before. Other control variables are: α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i on day t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ted_t is the TED spread on day t , i.e., the difference between the LIBOR and the T-Bill rate on day t ; and $adv_selection_{it}^{EBS}$ is the average 5-minutes price impact of trades on EBS for currency pair i on day t . In all regressions we include a currency pair fixed effect (ω_i), a monthly fixed effect ($\xi_{t,m}$) and a time trend (coefficients b_0 and a_0). t-statistics in parenthesis are calculated using robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

	<i>adv_selection</i>	
	1 st stage	2 nd stage
<i>AD</i>	0.034 (5.22)	
π^{tox}		3.395 (3.40)
φ	-0.043 (-1.14)	0.307 (1.72)
α	-0.696 (-5.14)	5.304 (4.86)
σ^{tox}	-0.001 (-0.15)	0.076 (2.56)
<i>vol</i>	-0.01 (-0.58)	1.247 (8.02)
<i>trsize</i>	-0.019 (-0.57)	-0.143 (-0.91)
<i>nrorders</i>	-0.002 (-3.49)	-0.017 (-6.62)
<i>ted</i>	-0.108 (-2.15)	0.122 (0.45)
<i>illiq^{EBS}</i>	0.003 (2.87)	-0.018 (-2.75)
Adj. R^2	9.9%	59.8%
<i>F – stats</i>	27.2	
Obs.		1,449
Currency FE		YES
Month FE		YES

Table IA.3.5: Regressions with $\log(nrarb^{tox})$ and $\log(nrarb^{nontox})$ instead of φ

In Panel A of this table, we reports estimates of the following equation: $illiq_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2 \log(nrarb_t^{tox}) + b_3 \log(nrarb_t^{nontox}) + b_4\alpha_t + b_5\sigma_t^{tox} + b_6vol_{it} + b_7trsize_{it} + b_8nrorders_{it} + b_9ted_t + b_{10}illiq_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $illiq_{it}$ (resp., $illiq_{it}^{EBS}$) is one of our four proxies for illiquidity for currency i in hour t ($spread_{it}$, $espread_{it}$, $slope_{it}$, and $adv_selection_{it}$) on Reuters D-3000 (resp., EBS). φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . We instrument π_t^{tox} with the introduction of AutoQuote on Reuters D-3000 (see the text). The first stage regression is: $\pi_t^{tox} = \omega_i + \xi_{t,m} + a_0t + a_1AD_t + a_2 \log(nrarb_t^{tox}) + a_3 \log(nrarb_t^{nontox}) + a_4\alpha_t + a_5\sigma_t^{tox} + a_6vol_{it} + a_7trsize_{it} + a_8nrorders_{it} + a_9ted_t + a_{10}illiq_{it}^{EBS} + u_{it}$, where AD_t is a dummy variable equal to one after July 2003 and zero before. Other control variables are: $\log(nrarb_t^{tox})$, the log of the number of toxic and non-toxic arbitrage opportunities on day t ; $\log(nrarb_t^{nontox})$ the log of the number of non-toxic arbitrage opportunities on day t ; α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i on day t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ted_t is the TED spread on day t , i.e., the difference between the LIBOR and the T-Bill rate on day t . In Panel B, we present estimates of the following regression $\log(duration_t) = h_i + \xi_{t,m} + k_0t + k_1AD_t + k_2 \log(nrarb_t^{tox}) + k_3 \log(nrarb_t^{nontox}) + k_4\alpha_t + k_5\sigma_t^{tox} + k_6vol_{it} + k_7trsize_{it} + k_8nrorders_{it} + k_9ted_t + k_{10}spread_{it}^{EBS} + u_{it}$, where $duration_t$ is the average duration of toxic arbitrage opportunities (*Toxic* column) on day t or any (both toxic and non-toxic) arbitrage opportunity (*All* column). In all regressions we include a currency pair fixed effect, a monthly fixed effect and a time trend. t-statistics in parenthesis are calculated using robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

Panel A: Illiquidity Regressions

	<i>spread</i>		<i>espread</i>		<i>slope</i>		<i>adv_selection</i>	
	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.028 (4.18)		0.030 (4.46)		0.027 (3.96)		0.027 (4.06)	
π^{tox}		8.309 (3.79)		2.871 (3.60)		6.280 (3.77)		3.124 (3.19)
$\log(nrarb^{tox})$	-0.030 (-2.60)	0.370 (4.12)	-0.031 (-2.65)	0.164 (4.62)	-0.029 (-2.48)	0.261 (3.78)	-0.030 (-2.58)	0.176 (4.42)
$\log(nrarb^{nontox})$	-0.037 (-3.32)	0.117 (0.88)	-0.037 (-3.32)	0.021 (0.42)	-0.037 (-3.30)	0.116 (1.17)	-0.038 (-3.41)	0.038 (0.66)
α	0.495 (1.75)	0.917 (0.44)	0.477 (1.71)	0.755 (0.91)	0.464 (1.61)	0.356 (0.22)	0.490 (1.76)	1.050 (1.17)
σ^{tox}	-0.010 (-2.01)	0.190 (3.65)	-0.010 (-2.11)	0.144 (6.25)	-0.010 (-2.04)	0.090 (2.40)	-0.009 (-1.94)	0.088 (3.78)
<i>vol</i>	0.028 (1.66)	1.160 (5.38)	0.029 (1.71)	0.650 (6.59)	0.032 (1.85)	0.634 (4.13)	0.026 (1.49)	0.650 (6.13)
<i>trsize</i>	0.009 (0.30)	-0.247 (-0.89)	0.004 (0.12)	-0.100 (-0.98)	0.009 (0.28)	-0.323 (-1.63)	0.006 (0.22)	-0.176 (-1.58)
<i>nrorders</i>	0.001 (1.52)	-0.050 (-9.63)	0.001 (1.51)	-0.019 (-9.23)	0.001 (1.40)	-0.030 (-7.98)	0.001 (1.57)	-0.020 (-8.51)
<i>ted</i>	-0.109 (-2.23)	1.097 (2.08)	-0.111 (-2.28)	0.474 (2.39)	-0.123 (-2.52)	0.849 (2.09)	-0.109 (-2.23)	0.486 (2.21)
<i>illiq^{EBS}</i>	0.002 (1.58)	0.009 (0.76)	0.004 (3.76)	-0.003 (-0.61)	0.002 (1.08)	-0.002 (-0.14)	0.004 (3.15)	-0.009 (-1.57)
Adj. R^2	13.4%	58.1%	13.8%	82.4%	13.6%	11.8%	13.8%	65.5%
<i>F - stats</i>	17.5		19.9		15.6		16.5	
Obs.		1,413		1,413		1,413		1,413
Currency FE		YES		YES		YES		YES
Month FE		YES		YES		YES		YES

Table IA.3.5*Panel B: Duration regressions*

	<i>Toxic</i>	<i>All</i>
<i>AD</i>	-0.085 (-4.77)	-0.092 (-6.12)
$\log(nrarb^{toxic})$	-0.309 (-9.58)	-0.325 (-15.1)
$\log(nrarb^{nontoxic})$	0.116 (3.37)	0.063 (2.45)
α	3.646 (4.88)	4.381 (9.44)
σ	0.082 (5.25)	0.102 (8.76)
<i>vol</i>	-0.126 (-2.13)	-0.120 (-2.47)
<i>trsize</i>	0.242 (2.49)	0.207 (2.47)
<i>nrorders</i>	-0.017 (-10.3)	-0.016 (-12.5)
<i>ted</i>	-0.173 (-1.11)	-0.244 (-1.92)
<i>spread</i> ^{<i>EBS</i>}	0.004 (1.01)	0.006 (1.69)
Adj. R^2	60.4%	71.1%
Obs.	1,449	1,449
Currency FE	YES	YES
Month FE	YES	YES

Table IA.3.6: Decomposition of φ

In Panel A of this table, we present OLS estimates of the following predictive regression for φ_t : $\varphi_{t+1} = a_0 + \xi_{t,m} + \sum_{i \in \{GU, EU, GE\}} (a_i spread_{it} + b_i vol_{it} + c_i nrorders_{it}) + \sum_{j \in \{1, 2, \dots, 20\}} d_j \varphi_{t+1-j} + u_{t+1}$, where φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities in this day; $spread_{it}$ is the average quoted bid-ask spread (in basis points) in currency pair i on day t ; vol_{it} is the realized volatility (in percentage) of 5-minute returns for currency pair i on day t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $\xi_{t,m}$ is a monthly fixed effect (a dummy equal to one if day t is in month m). We denote the anticipated component of the regression by $\varphi^{anticipated}$ and the unanticipated component (the residual) by $\varphi^{surprise}$. Panel B reports estimates of the following equation: $illiq_{it} = \omega_i + \xi_{t,m} + b_0 t + b_1 \pi_t^{tox} + b_2 \varphi_t^{surprise} + b_3 \varphi_t^{anticipated} + b_4 \alpha_t + b_5 \sigma_t^{tox} + b_6 vol_{it} + b_7 trsize_{it} + b_8 nrorders_{it} + b_9 ted_t + b_{10} illiq_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $illiq_{it}$ (resp., $illiq_{it}^{EBS}$) is one of our four proxies for illiquidity for currency i in hour t ($spread_{it}$, $espread_{it}$, $slope_{it}$, and $adv_selection_{it}$) on Reuters D-3000 (resp., EBS). φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . We instrument π_t^{tox} with the introduction of AutoQuote on Reuters D-3000 (see the text). The first stage regression is: $\pi_t^{tox} = \omega_i + \xi_{t,m} + a_0 t + a_1 AD_t + a_2 \varphi_t^{surprise} + a_3 \varphi_t^{anticipated} + a_4 \alpha_t + a_5 \sigma_t^{tox} + a_6 vol_{it} + a_7 trsize_{it} + a_8 nrorders_{it} + a_9 illiq_{it}^{EBS} + a_{10} ted_t + a_{11} t + u_{it}$, where AD_t is a dummy variable equal to one after July 2003 and zero before. Other control variables are: α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i on day t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ted_t is the TED spread on day t , i.e., the difference between the LIBOR and the T-Bill rate on day t ; Panel C presents OLS estimates of the following equation: $\log(duration_t) = h_i + \xi_{t,m} + k_0 t + k_1 AD_t + k_2 \varphi_t^{surprise} + k_3 \varphi_t^{anticipated} + k_4 \alpha_t + k_5 \sigma_t^{tox} + k_6 vol_{it} + k_7 trsize_{it} + k_8 nrorders_{it} + k_9 ted_t + k_{10} spread_{it}^{EBS} + u_{it}$, where $duration_t$ is the average duration of toxic arbitrage opportunities (*Toxic* column) on day t or any (both toxic and non-toxic) arbitrage opportunity (*All* column). In all regressions we include currency fixed effects, monthly fixed effects and a trend. t-statistics in parenthesis are calculated based on robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

Panel A: Predictive Regression for φ

<i>jan</i>	0.014 (1.19)	φ_{t-1}	0.008 (0.14)
<i>feb</i>	-0.008 (-0.56)	φ_{t-2}	0.098 (2.06)
<i>mar</i>	0.007 (0.54)	φ_{t-3}	0.001 (0.01)
<i>apr</i>	0.009 (0.64)	φ_{t-4}	0.119 (2.09)
<i>may</i>	0.007 (0.48)	φ_{t-5}	0.059 (1.24)
<i>jun</i>	0.008 (0.62)	φ_{t-6}	-0.054 (-1.11)
<i>jul</i>	-0.006 (-0.40)	φ_{t-7}	0.040 (1.05)
<i>aug</i>	-0.013 (-0.91)	φ_{t-8}	-0.091 (-2.00)
<i>sep</i>	-0.017 (-1.36)	φ_{t-9}	-0.015 (-0.29)
<i>oct</i>	-0.015 (-1.29)	φ_{t-10}	0.110 (2.49)
<i>nov</i>	-0.013 (-1.59)	φ_{t-11}	0.046 (0.92)
<i>spread_{GU,t-1}</i>	0.020 (1.46)	φ_{t-12}	0.029 (0.64)
<i>spread_{EU,t-1}</i>	-0.015 (-2.48)	φ_{t-13}	-0.004 (-0.08)
<i>spread_{GE,t-1}</i>	0.054 (2.62)	φ_{t-14}	0.006 (0.12)
<i>nrorders_{GU,t-1}</i>	0.002 (1.09)	φ_{t-15}	-0.030 (-0.53)
<i>nrorders_{EU,t-1}</i>	-0.002 (-1.89)	φ_{t-16}	-0.075 (-1.74)
<i>nrorders_{GE,t-1}</i>	0.004 (2.55)	φ_{t-17}	0.016 (0.37)
<i>vol_{GU,t-1}</i>	-0.041 (-1.04)	φ_{t-18}	0.015 (0.32)
<i>vol_{EU,t-1}</i>	0.009 (0.44)	φ_{t-19}	0.019 (0.35)
<i>vol_{GE,t-1}</i>	-0.004 (-0.05)	φ_{t-20}	0.047 (0.99)
		Constant	0.197 (3.98)
Adj. R^2			28.1%
Obs.			463

Table IA.3.6 continued.

Panel B: Illiquidity Regressions

	<i>spread</i>		<i>espread</i>		<i>slope</i>		<i>adv_selection</i>	
	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.026 (3.20)		0.028 (3.46)		0.024 (2.90)		0.025 (3.10)	
π^{tox}		3.625 (2.30)		0.763 (1.20)		3.507 (2.56)		0.320 (0.42)
$\varphi^{surprise}$	-0.058 (-1.49)	0.526 (2.47)	-0.058 (-1.49)	0.192 (2.16)	-0.058 (-1.48)	0.412 (2.43)	-0.055 (-1.41)	0.200 (2.33)
$\varphi^{anticipated}$	0.076 (0.91)	2.320 (4.87)	0.069 (0.82)	1.143 (5.92)	0.082 (0.98)	1.252 (3.16)	0.078 (0.93)	1.294 (6.02)
α	-0.795 (-5.45)	6.403 (4.22)	-0.811 (-5.59)	2.404 (3.75)	-0.832 (-5.70)	5.312 (3.92)	-0.802 (-5.52)	2.603 (3.46)
σ^{tox}	-0.001 (-0.07)	0.119 (3.78)	-0.001 (-0.14)	0.121 (7.59)	-0.001 (-0.10)	0.034 (1.56)	0.001 (0.02)	0.062 (4.02)
<i>vol</i>	-0.014 (-0.80)	1.355 (8.17)	-0.014 (-0.76)	0.708 (8.62)	-0.010 (-0.57)	0.808 (6.88)	-0.017 (-0.94)	0.711 (8.17)
<i>trsize</i>	-0.010 (-0.28)	-0.236 (-1.41)	-0.016 (-0.44)	-0.109 (-1.74)	-0.011 (-0.31)	-0.318 (-2.35)	-0.012 (-0.33)	-0.202 (-2.98)
<i>nrorders</i>	-0.002 (-3.57)	-0.037 (-11.3)	-0.002 (-3.60)	-0.015 (-11.1)	-0.002 (-3.59)	-0.019 (-6.93)	-0.002 (-3.59)	-0.015 (-9.38)
<i>ted</i>	-0.125 (-2.21)	0.709 (2.23)	-0.127 (-2.27)	0.258 (2.45)	-0.143 (-2.55)	0.514 (1.98)	-0.122 (-2.42)	0.157 (1.11)
<i>illiq</i> ^{EBS}	0.002 (1.48)	0.015 (2.27)	0.004 (3.44)	0.004 (1.21)	0.0019 (1.14)	0.001 (0.04)	0.003 (2.68)	-0.001 (-0.02)
Adj. R^2	10.8%	85.2%	11.1%	92.6%	11.2%	63.8%	11.1%	85.1%
$F - stats$	10.2		11.9		8.4		9.6	
Obs.		1,389		1,389		1,389		1,389
Currency FE		YES		YES		YES		YES
Month FE		YES		YES		YES		YES

Table IA.3.6 continued.*Panel C: Duration Regressions*

	<i>Toxic</i>	<i>All</i>
<i>AD</i>	-0.053 (-2.42)	-0.055 (-2.89)
$\varphi^{surprise}$	-0.993 (-7.65)	-0.899 (-8.26)
$\varphi^{anticipated}$	-1.280 (-5.72)	-1.137 (-6.03)
α	-0.251 (-0.59)	-0.601 (-1.47)
σ^{tox}	0.119 (7.28)	0.129 (8.62)
<i>vol</i>	-0.228 (-3.50)	-0.241 (-4.20)
<i>trsize</i>	0.160 (1.53)	0.123 (1.27)
<i>nrorders</i>	-0.022 (-15.2)	-0.024 (-17.3)
<i>ted</i>	-0.227 (-1.41)	-0.286 (-2.13)
<i>spread</i> ^{EBS}	0.004 (1.08)	0.005 (1.47)
Adj. R^2	58.3%	66.5%
Obs.	1,389	1,389
Month FE	YES	YES

Table IA.3.7: Alternative Classification of Arbitrage Opportunities

In this table, we report estimates of eq.(24) and eq.(26) when we classify arbitrage opportunities into toxic and non toxic arbitrage opportunities as described in Section 4.4 (last paragraph). This alternative approach to classify arbitrage opportunities into toxic and non toxic opportunities affect the values of π_t^{tox} , φ_t , and σ_t^{tox} . Other variables are unchanged. we report estimates of the following equation: $illiq_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2\varphi_t + b_3\alpha_t + b_4\sigma_t^{tox} + b_5vol_{it} + b_6trsize_{it} + b_7nrorders_{it} + b_8ted_t + b_9illiq_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $illiq_{it}$ (resp., $illiq_{it}^{EBS}$) is one of our four proxies for illiquidity for currency i in day t ($spread_{it}$, $espread_{it}$, $slope_{it}$, and $adv_selection_{it}$) on Reuters D-3000 (resp., EBS). φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities in day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . We instrument π_t^{tox} with the introduction of AutoQuote on Reuters D-3000 (see the text). The first stage regression is: $\pi_t^{tox} = \omega_i + \xi_{t,m} + a_0t + a_1AD_t + a_2\varphi_t + a_3\alpha_t + a_4\sigma_t^{tox} + a_5vol_{it} + a_6trsize_{it} + a_7nrorders_{it} + a_8ted_t + a_9illiq_{it}^{EBS} + u_{it}$, where AD_t is a dummy variable equal to one after July 2003 and zero before. Other control variables are: α_t is the number of all arbitrage opportunities in day t divided by the total number of trades this day; σ_t^{tox} is the average size of toxic arbitrage opportunities in day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i in hour t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; Panel B presents estimates of the following regression $\log(duration_t) = h_i + \xi_{t,m} + k_0t + k_1AD_t + k_2\varphi_t + k_3\alpha_t + k_4\sigma_t^{tox} + k_5vol_{it} + k_6trsize_{it} + k_7nrorders_{it} + k_8ted_t + u_{it}$, where $duration_t$ is the average duration of toxic arbitrage opportunities (*Toxic* column) on day t or any (both toxic and non-toxic) arbitrage opportunity (*All* column). In all regressions we include currency fixed effects, monthly fixed effects and a trend. t-statistics in parenthesis are calculated based on robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2003 to December 30, 2004.

Table IA.3.7 continued.

Panel A: Illiquidity Regressions

	<i>spread</i>		<i>espread</i>		<i>slope</i>		<i>adv_selection</i>	
	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage	1 st stage	2 nd stage
<i>AD</i>	0.029 (3.79)		0.031 (4.04)		0.028 (3.64)		0.027 (3.59)	
π^{tox}		7.831 (3.48)		2.558 (3.20)		5.982 (3.49)		2.973 (2.83)
φ	-0.079 (-1.38)	1.149 (2.76)	-0.079 (-1.38)	0.474 (3.02)	-0.079 (-1.37)	0.804 (2.53)	-0.075 (-1.31)	0.431 (2.48)
α	-0.799 (-4.88)	9.896 (4.15)	-0.818 (-5.01)	4.008 (4.56)	-0.821 (-5.01)	7.347 (3.98)	-0.797 (-4.86)	4.915 (4.37)
σ^{tox}	-0.005 (-0.85)	0.154 (3.20)	-0.006 (-0.96)	0.124 (6.17)	-0.005 (-0.87)	0.063 (1.74)	-0.004 (-0.76)	0.075 (3.50)
<i>vol</i>	-0.008 (-0.44)	1.463 (6.81)	-0.007 (-0.38)	0.777 (7.95)	-0.005 (-0.26)	0.855 (5.67)	-0.011 (-0.55)	0.793 (7.48)
<i>trsize</i>	-0.022 (-0.58)	-0.056 (-0.19)	-0.028 (-0.74)	-0.028 (-0.27)	-0.022 (-0.60)	-0.192 (-0.86)	-0.023 (-0.61)	-0.119 (-0.97)
<i>nrorders</i>	-0.001 (-0.48)	-0.042 (-9.97)	-0.001 (-0.53)	-0.016 (-9.73)	-0.001 (-0.59)	-0.024 (-7.86)	-0.001 (-0.49)	-0.015 (-8.11)
<i>ted</i>	-0.070 (-1.23)	0.706 (1.35)	-0.073 (-1.28)	0.300 (1.63)	-0.089 (-1.55)	0.495 (1.21)	-0.066 (-1.17)	0.280 (1.32)
<i>illiq</i> ^{EBS}	0.003 (1.93)	0.002 (0.14)	0.005 (4.08)	-0.004 (-0.85)	0.004 (2.14)	-0.015 (-1.17)	0.004 (2.65)	-0.009 (-1.44)
Adj. R^2	8.6%	48.3%	9.0%	80.0%	8.9%	28.6%	8.7%	57.3%
$F - stats$	14.4		16.3		13.3		12.9	
Obs.		1,449		1,449		1,449		1,449
Currency FE		YES		YES		YES		YES
Month FE		YES		YES		YES		YES

Table IA.3.7 continued.*Panel B: Duration Regressions*

	<i>Toxic</i>	<i>All</i>
<i>AD</i>	-0.058 (-3.11)	-0.057 (-3.69)
φ	-1.203 (-9.06)	-1.126 (-10.1)
α	0.076 (0.17)	-0.257 (-0.66)
σ^{tox}	0.109 (7.19)	0.129 (9.37)
<i>vol</i>	-0.208 (-3.15)	-0.222 (-4.16)
<i>trsize</i>	0.116 (1.08)	0.109 (1.22)
<i>nrorders</i>	-0.020 (-13.0)	-0.022 (-16.7)
<i>ted</i>	-0.130 (-0.73)	-0.157 (-1.23)
<i>spread</i> ^{EB5}	0.007 (1.44)	0.005 (1.27)
Adj. R^2	55.0%	68.0%
Obs.	1,449	1,449
Currency FE	YES	YES
Month FE	YES	YES

IA.4. 2005-2011 Sample

In this section, we present estimates of eq.(24) and eq.(26) in our paper with a different sample for the three currency pairs covered in our paper. The data are obtained from Thomson Reuters Tick History dataset by the Securities Industry Research Centre of Asia-Pacific. For each currency pair (GBP/USD, EUR/USD, and EUR/GBP), we observe tick by tick data for the best bid and ask quotes and trades on Reuters D-3000. In contrast to the data used in our paper, we do not observe the size of trades and the quoted depth. Hence, we cannot use *slope* as a measure of illiquidity. The sample period starts from January 2, 2005 to December 30, 2011. For this sample, we first provide descriptive statistics for the variables used in our tests (Tables IA.4.1 and IA.4.3) and we then estimate eq.(24) and eq.(26) with OLS (Table IA.4.4).

Table IA.4.1: Descriptive Statistics: 2005-2011 Sample

This table presents the descriptive statistics for the variables used in our tests with the extended sample for each currency pair $i \in \{GU, EU, EG\}$, where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day; α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; $duration_t^{all}$ denotes the duration in seconds of all arbitrage opportunities on day t ; $duration_t^{tox}$ ($duration_t^{nontox}$) denotes the average duration in seconds of toxic (non-toxic) arbitrage opportunities on day t ; $nrarb_t^{tox}$ ($nrarb_t^{nontox}$) is the number of toxic (non-toxic) arbitrage opportunities on day t ; π_t^{tox} (π_t^{nontox}) is the number of toxic (non-toxic) arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic (non-toxic) arbitrage opportunities on this day; σ_t^{tox} (σ_t^{nontox}) is the average size of toxic (non-toxic) arbitrage opportunities on day t (in basis points); $profit_t^{tox}$ ($profit_t^{nontox}$) is the average profit in basis points on toxic (non-toxic) triangular arbitrage opportunities on day t (calculated as explained in Section 3.2). The sample period is from January 2, 2005 to December 30, 2011.

Panel A: Common Variables

Variable	Mean	Std.Dev.	Min	Q1	Median	Q3	Max
$duration^{all}$	0.783	0.469	0.222	0.359	0.712	1.104	3.971
φ	0.405	0.092	0.118	0.349	0.412	0.466	0.722
α	0.041	0.023	0.003	0.022	0.039	0.054	0.161

Panel B: Toxic Arbitrage

Variable	Mean	Std.Dev.	Min	Q1	Median	Q3	Max
$duration^{tox}$	0.885	0.652	0.150	0.372	0.749	1.234	10.86
$nrarb^{tox}$	50.55	36.56	2	24	42	68	359
π^{tox}	0.800	0.138	0.227	0.726	0.829	0.895	1.000
σ^{tox}	3.104	3.270	1.363	1.988	2.190	2.522	40.95
$profit^{tox}$	0.627	0.201	0.285	0.520	0.583	0.670	2.836

Panel C: Non-toxic Arbitrage

Variable	Mean	Std.Dev.	Min	Q1	Median	Q3	Max
$duration^{nontox}$	0.726	0.440	0.228	0.330	0.626	1.028	2.919
$nrarb^{nontox}$	70.76	40.34	2	40	66	95	290
π^{nontox}	0.829	0.123	0.100	0.767	0.846	0.913	1
σ^{nontox}	2.932	3.532	1.399	1.814	1.990	2.267	55.77
$profit^{nontox}$	0.591	0.413	0.296	0.452	0.499	0.589	10.71

Table IA.4.1 continued.*Panel D: (Il)liquidity Measures*

Variable	Mean	Std.Dev.	Min	Q1	Median	Q3	Max
<i>spread_{GU}</i>	2.613	0.765	1.710	2.219	2.426	2.680	8.343
<i>spread_{EG}</i>	1.528	0.671	0.770	1.044	1.378	1.781	6.693
<i>spread_{EU}</i>	3.230	2.171	1.306	2.063	2.371	3.417	11.93
<i>espread_{GU}</i>	1.710	0.363	1.227	1.516	1.627	1.757	4.685
<i>espread_{EG}</i>	0.904	0.289	0.542	0.685	0.855	1.025	2.748
<i>espread_{EU}</i>	3.042	4.179	0.975	1.419	1.639	2.130	24.64
<i>adv_selection_{GU}</i>	0.991	0.262	0.598	0.857	0.929	1.028	3.163
<i>adv_selection_{EG}</i>	0.508	0.204	0.220	0.357	0.479	0.590	1.971
<i>adv_selection_{EU}</i>	1.970	2.620	0.528	0.852	1.028	1.388	16.86

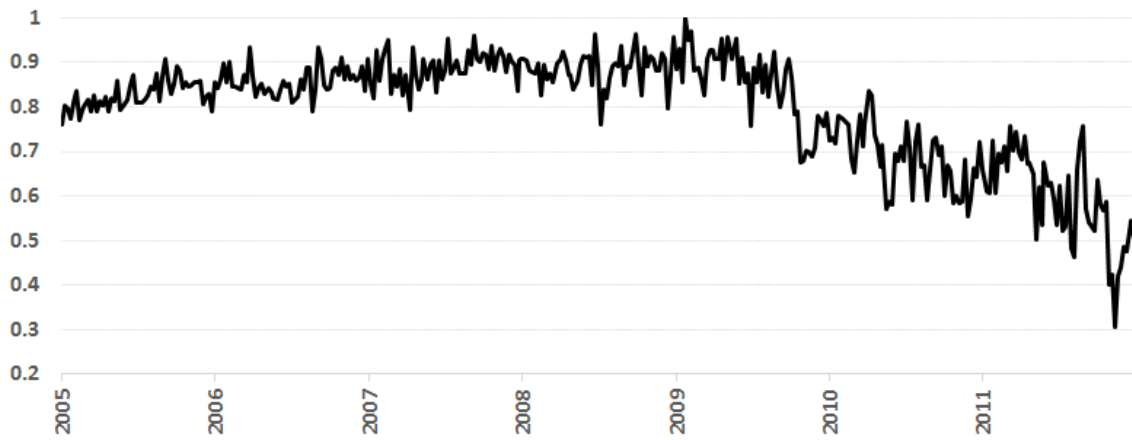
Panel E: Control Variables

Variable	Mean	Std.Dev.	Min	Q1	Median	Q3	Max
<i>vol_{GU}</i>	0.532	0.234	0.191	0.386	0.482	0.589	2.407
<i>vol_{EG}</i>	0.431	0.203	0.157	0.280	0.395	0.511	1.972
<i>vol_{EU}</i>	0.525	0.209	0.186	0.383	0.483	0.615	1.872
<i>nrorders_{GU}</i>	15.07	6.139	4.151	9.589	14.14	19.88	44.05
<i>nrorders_{EG}</i>	12.34	7.014	2.885	5.566	11.22	18.41	43.91
<i>nrorders_{EU}</i>	11.45	5.711	0.025	7.877	10.73	14.86	36.06
<i>nrtr_{GU}</i>	5.256	1.430	1.520	4.170	5.162	6.158	12.99
<i>nrtr_{EG}</i>	2.897	0.893	0.648	2.255	2.721	3.380	7.690
<i>nrtr_{EU}</i>	0.989	0.470	0.054	0.629	0.937	1.314	2.450
Obs.				1,679			

Figure IA.4.2: Evolution of π_t^{tox} and φ_t over Time

Panel A shows the time series of π_t^{tox} , defined as the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on this day. Panel B shows the time series of φ_t , defined as the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day. The sample period is from January 2, 2005 to December 30, 2011.

Panel A: Evolution of $\pi - t^{tox}$ for extended sample



Panel B: Evolution of φ_t for the extended sample

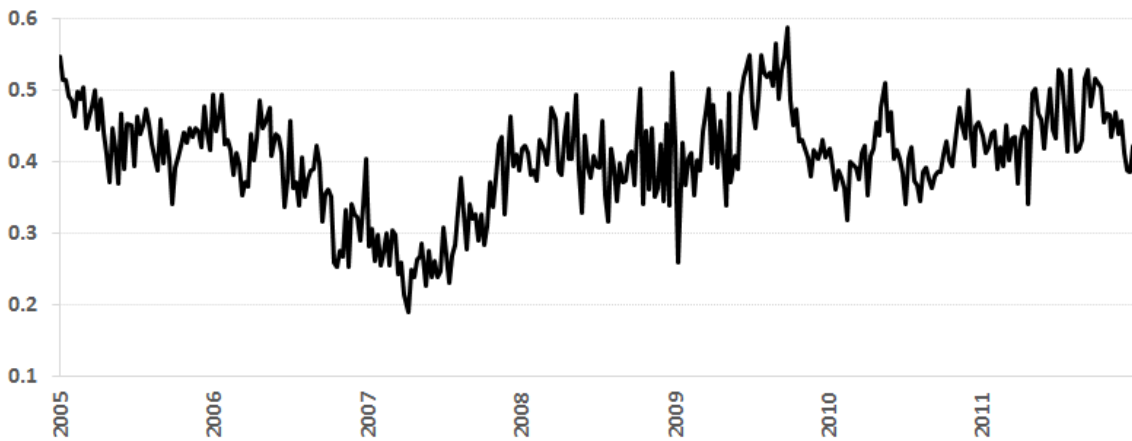


Table IA.4.3: Correlations: 2005-2011 Sample

This table presents correlations between the daily realizations of the variables used in our tests with the 2005-2011 sample. Indexes *GU*, *EU*, and *EG* refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $duration^{all}$ is the average duration of all arbitrage opportunities on day t . $duration_t^{tox}$ denotes the average duration in seconds of toxic arbitrage opportunities on day t ; α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; π_t^{tox} (resp., π_t^{nontox}) is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic (non-toxic) arbitrage opportunities on day t ; φ_t is the number of toxic (resp., non-toxic) arbitrage opportunities on day t divided by the number of arbitrage opportunities on that day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); $spread_{it}$ is the average quoted bid-ask spread (in basis points) in currency pair i on day t ; $espread_{it}$ is the average effective spreads (in basis points) in currency pair i on day t ; $slope_{it}$ is the average slope of the limit order book in currency pair i on day t ; adv_sel_{it} is a the price average 1-minute price impact of trades on day t for currency pair i . The last line reports the correlation between each illiquidity measure on Reuters for currency pair i and its counterpart on EBS. The sample period is from January 2, 2005 to December 30, 2011. Values with ***, ** and * are significant at 1%, 5% and 10% level respectively.

	$duration^{all}$	φ	α	σ^{tox}	$spread_{GU}$	$spread_{EG}$	$spread_{EU}$	$espread_{GU}$	$espread_{EG}$	$espread_{EU}$	adv_sel_{GU}	adv_sel_{EG}	adv_sel_{EU}	π^{nontox}
π^{tox}	0.32***	-0.26***	-0.31***	0.23***	0.16***	-0.06***	0.38***	0.18***	-0.13***	0.26***	0.16***	-0.10***	0.25***	0.58***
$duration^{all}$	1	-0.15***	0.38***	-0.11***	-0.15***	-0.47***	-0.10***	-0.12***	-0.50***	-0.14***	-0.11***	-0.48***	-0.18***	-0.14***
φ		1	0.15***	0.04	0.20***	0.25***	0.07***	0.23***	0.29***	0.02	0.24***	0.28***	0.05***	-0.25*
α			1	-0.36***	-0.27***	-0.36***	-0.52***	-0.21***	-0.32***	-0.44***	-0.21***	-0.33***	-0.46***	-0.57***
σ^{tox}				1	0.84***	0.71***	0.82***	0.83***	0.69***	0.89***	0.82***	0.70***	0.87***	0.29***
$spread_{GU}$					1	0.87***	0.82***	0.98***	0.83***	0.87***	0.97***	0.84***	0.86***	0.23***
$spread_{EG}$						1	0.70***	0.83***	0.98***	0.76***	0.81***	0.98***	0.77***	0.21***
$spread_{EU}$							1	0.80***	0.65***	0.93***	0.79***	0.67***	0.91***	0.42***
$espread_{GU}$								1	0.81***	0.84***	0.98***	0.82***	0.84***	0.21***
$espread_{EG}$									1	0.72***	0.79***	0.99***	0.73***	0.14***
$espread_{EU}$										1	0.83***	0.74***	0.97***	0.34***
adv_sel_{GU}											1	0.16***	0.35***	0.19***
adv_sel_{EG}												1	0.82***	0.16***
adv_sel_{EU}													1	0.35***

Table IA.4.4: Arbitrageurs' Relative Speed (π^{tox}), Arbitrage Mix (φ) and Liquidity: 2005-2011 Sample

Panel A (Columns 2, 4, and 6) of this table reports OLS estimates of the following equation: $illiq_{it} = \omega_i + \xi_{t,m} + b_0t + b_1\pi_t^{tox} + b_2\varphi_t + b_3\alpha_t + b_4\sigma_t^{tox} + b_5vol_{it} + b_6trsize_{it} + b_7nrorders_{it} + b_8ted_t + b_9illiq_{it}^{EBS} + \varepsilon_{it}$, for $i \in \{GU, EU, EG\}$ where indexes GU , EU , and EG refer to the GBP/USD, EUR/USD, and EUR/GBP currency pairs, respectively. $illiq_{it}$ is one of our four proxies for illiquidity for currency i on day t ($spread_{it}$, $espread_{it}$, $slope_{it}$, and $adv_selection_{it}$). φ_t is the number of toxic arbitrage opportunities on day t divided by the number of arbitrage opportunities on this day and π_t^{tox} is the number of toxic arbitrage opportunities on day t that terminate with a trade divided by the total number of toxic arbitrage opportunities on day t . Other control variables are: α_t is the number of all arbitrage opportunities on day t divided by the total number of trades on this day; σ_t^{tox} is the average size of toxic arbitrage opportunities on day t (in basis points); vol_{it} is the realized volatility (in percentage) of 5-minutes returns for currency pair i on day t ; $nrorders_{it}$ (in thousands) is the total number of orders (market, limit or cancelations) in currency pair i on day t ; $trsize_{it}$ is the average daily trade size (in million) for currency pair i on day t ; ted_t is the TED spread on day t , i.e., the difference between the LIBOR and the T-Bill rate on day t . In Columns 3, 5, and 7, we replace φ by its anticipated component, $\varphi^{anticipated}$ and its unanticipated component, $\varphi^{surprise}$, which we estimate as in Panel A of Table IA.3.6 in this Internet Appendix. In Panel B, we estimate the same equation but we interact the coefficients on π_t^{tox} and φ with a dummy variable, D^{crisis} , which equal to 1 when day t is between September 2008-June 2009 and 0 otherwise. In panel C, $\log(duration_t) = h_i + \xi_{t,m} + k_0t + k_1AD_t + k_2\varphi_t + k_3\alpha_t + k_4\sigma_t^{tox} + k_5vol_{it} + k_6trsize_{it} + k_7nrorders_{it} + k_8ted_t + u_{it}$, where $duration_t$ is the average duration of toxic arbitrage opportunities (*Toxic* columns) on day t or any (both toxic and non-toxic) arbitrage opportunity (*All* columns). In all regressions we include currency fixed effects, monthly fixed effects and a trend. t-statistics in parenthesis are calculated based on robust standard errors correcting for heteroscedasticity and serial correlation. The sample period is from January 2, 2005 to December 30, 2011.

Panel A: Liquidity Regressions

	<i>spread</i>		<i>espread</i>		<i>adv_selection</i>	
π^{tox}	0.530 (3.97)	0.654 (5.02)	0.137 (0.60)	0.314 (5.02)	0.146 (0.96)	0.273 (1.82)
φ	1.638 (11.3)		2.023 (6.89)		1.330 (7.06)	
$\varphi^{surprise}$		-0.010 (-0.05)		-0.240 (-0.63)		-0.289 (-1.19)
$\varphi^{anticipated}$		4.417 (23.0)		5.858 (16.0)		4.051 (16.3)
α	-4.256 (-5.77)	-5.638 (-7.86)	1.751 (1.34)	-0.081 (-0.07)	-0.189 (-0.22)	-1.540 (-1.88)
σ^{tox}	0.055 (4.74)	0.058 (5.14)	0.082 (2.64)	0.084 (2.81)	0.036 (1.86)	0.038 (2.03)
<i>vol</i>	3.810 (19.6)	3.673 (19.7)	8.107 (18.5)	7.946 (18.6)	5.261 (18.1)	5.142 (18.2)
<i>nrorders</i>	-0.129 (-21.1)	-0.137 (-22.7)	-0.390 (-30.7)	-0.402 (-31.7)	-0.233 (-28.0)	-0.241 (-29.0)
<i>ted</i>	0.006 (0.17)	0.049 (1.50)	-0.128 (-1.95)	-0.068 (-1.06)	-0.077 (-1.85)	-0.035 (-0.86)
Adj. R^2	76.7%	78.1%	73%	74%	71.5%	72.8%
Obs	5,037	4,974	5,037	4,974	5,037	4,974
Currency FE	YES		YES		YES	
Month FE	YES		YES		YES	

Table IA.4.4 continued.

Panel B: Accounting for the 2007-2008 Crisis

	<i>spread</i>	<i>espread</i>	<i>adv_selection</i>
π^{tox}	0.618 (4.79)	0.228 (1.17)	0.269 (2.04)
$\pi^{tox} \times D^{crisis}$	-0.911 (-1.28)	-0.931 (-0.58)	-1.304 (-1.31)
φ	1.986 (14.3)	2.533 (10.3)	1.614 (9.92)
$\varphi \times D^{crisis}$	-2.380 (-3.64)	-3.487 (-2.18)	-1.952 (-2.09)
α	-4.240 (-5.82)	1.682 (1.33)	-0.048 (-0.06)
σ^{tox}	0.055 (4.78)	0.080 (2.64)	0.037 (1.99)
<i>vol</i>	3.711 (19.3)	7.967 (18.1)	5.175 (18.0)
<i>nrorders</i>	-0.128 (-21.3)	-0.390 (-30.6)	-0.233 (-28.1)
<i>ted</i>	0.005 (0.15)	-0.128 (-1.95)	-0.079 (-1.94)
Adj. R^2	76.9%	73.2%	71.6%
Obs	5,037	5,037	5,037
Currency FE	YES	YES	YES
Month FE	YES	YES	YES

Panel C: Duration of Arbitrage Opportunities

	<i>Toxic</i>		<i>All</i>	
φ	-0.708 (-9.75)	-0.839 (-11.4)	-0.297 (-5.78)	-0.361 (-6.93)
$\varphi \times D^{crisis}$		0.889 (3.39)		0.436 (2.12)
α	2.507 (7.39)	2.583 (7.62)	3.159 (12.1)	3.194 (12.3)
σ^{tox}	-0.008 (-1.74)	-0.007 (-1.51)	0.002 (0.39)	0.002 (0.44)
<i>vol</i>	0.043 (0.60)	0.077 (1.08)	-0.135 (-2.21)	-0.117 (-1.89)
<i>nrorders</i>	-0.012 (-5.58)	-0.012 (-5.71)	-0.010 (-6.13)	-0.010 (-6.22)
<i>ted</i>	0.199 (11.1)	0.198 (11.0)	0.142 (10.4)	0.142 (10.4)
Adj. R^2	67.4%	67.5%	78.3%	78.4%
Obs.	5,037	5,037	5,037	5,037
Month FE	YES	YES	YES	YES

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