Internet Appendix for

**"The Role of Reputation in Financial Markets:
The Impact of Broker Dark Pool Scandals on Institutional Order Routing"**

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This appendix provides additional analysis to support the main text. The contents include the following:

Internet Appendix Table IA.1: Identification of Dark Pool Event Announcement Dates

This tables provides excerpts from the earliest article found related to each dark pool event in the sample. These articles are used to identify the announcement date associated with each event.

Pipeline – October 24, 2011

Nature of Violation: Failed to disclose role of affiliate in trading

Reuters.com on October 24, 2011: "Pipeline Settles SEC Case." By Sarah Lynch.

"SEC charges Pipeline with misleading investors. Pipeline to pay $1 million to settle charges. Pipeline executives to pay $100,000 each. This marks first-ever SEC case against a dark pool."

"Pipeline, unlike many of the other successful U.S. dark pools, is not run by a larger bank. It competes with Investment Technology Group's Posit and Liquidnet and others for larger blocks of stock traded by institutions looking to hide their intentions from the wider marketplace, where far smaller-sized trades are done."

Traders Magazine on December 1, 2011: "Pipeline Fine Shocks Trading World." By Editorial Staff.

"Traders were shocked this year when Pipeline Trading Systems agreed to pay $1 million to settle charges brought by the Securities and Exchange Commission. Regulators alleged the company failed to disclose that, at times, more than 97 percent of the orders in its dark pool were filled by a trading operation affiliated with the firm."

"People were using that pool with an expectation that it was natural liquidity," said one veteran broker. "Maybe Pipeline thought what they were doing was fair, but it's disappointing."

Liquidnet – June 22, 2012.

Nature of Violation: Failed to protect customer trade information

Law306.com on June 22, 2012: "Liquidnet Says Dark Pool Disclosures Drew SEC Reproach." By Max Stendahl.

"Liquidnet Holdings Inc., the operator of a so-called dark pool stock trading network, revealed Friday that the U.S. Securities and Exchange Commission had faulted it for disclosing information about the trading habits of its members. The SEC recently inspected Liquidnet and determined it had improperly provided "descriptive characteristics" about member clients to corporations that use the trading platform to sell and buy back their shares, company spokeswoman Melissa Kanter said. She said the inspection was not related to Liquidnet's core trading business."

Knight Capital Group – August 2, 2012

Nature of Violation: Trading error

New York Times on August 2, 2012: "Knight Capital Says Trading Glitch Cost it $440 Million." By Nathaniel Popper

"The Knight Capital Group announced on Thursday that it lost $440 million when it sold all the stocks it accidentally bought Wednesday morning because a computer glitch. The losses are threatening the stability of the firm, which is based in Jersey City. In its statement, Knight Capital said its capital base, the money it uses to conduct its business, had been "severely impacted" by the event and that it was "actively pursuing its strategic and financing alternatives." The losses are greater than the company's revenue in the second quarter of this year, when it brought in $289 million. "With the events of yesterday, you have to question if this is the beginning of the end for Knight," said Christopher Nagy, founder of the consulting firm KOR Trading."

Level (eBX) – October 3, 2012

Nature of Violation: Failed to protect customer trade information

Traders Magazine on October 3, 2012: "LeveL ATS Failed to Protect Info on Unexecuted Orders, SEC Says." By Editorial Staff.

The Securities and Exchange Commission charged Wednesday that the operator of the Level ATS failed to protect information about unexecuted orders in its dark pool. The regulator said eBX LLC, which operates the LeveL alternate trading system, did not "protect the confidential trading information of its subscribers," allowing an outside technology firm to use information about LeveL subscribers' unexecuted orders, for its own "business purposes."

Barclays – May 9, 2014.

Nature of Violation: Misled investors about the role of HFTs in trading

WSJ on May 9, 2014: "Goldman, Barclays, Credit Suisse Draw High-Speed Trading Scrutiny: Banks Have Received Requests for Information from N.Y. Attorney General." By Justin Baer and Scott Patterson.

"New York's attorney general is scrutinizing the private stock-trading venues run by Goldman Sachs Group Inc., Barclays PLC, Credit Suisse Group AG and others as part of a probe into whether high-frequency-trading firms have enjoyed unfair advantages over other investors, people familiar with the matter said. The banks have received requests for information from New York Attorney General Eric Schneiderman's office, which is investigating whether high-speed firms made secret arrangements with exchanges and other venues that allow them to gain an edge, the people said."

WSJ on June 25, 2014: "New York Attorney General Sues Barclays Over Stock-Trading Business." By Scott Patterson and Andrew R. Johnson

"New York Attorney General Eric Schneiderman sued British banking giant Barclays for allegedly lying about how it favors high-frequency players in the firm's stock-trading business. The civil suit filed Wednesday alleged that Barclays engaged in fraudulent activity related to a trading venue known as a "dark pool," in which buy and sell orders aren't reported to the public, allowing investors to hide their trading interest and evade faster-moving firms."

Credit Suisse – May 9, 2014.

Nature of Violation: Misled investors about the role of HFTs in trading

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Goldman Sachs – May 9, 2014

Nature of Violation: Violation of trade pricing rules

WSJ on May 9, 2014: "Goldman, Barclays, Credit Suisse Draw High-Speed Trading Scrutiny: Banks Have Received Requests for Information from N.Y. Attorney General." By Justin Baer and Scott Patterson.

"New York's attorney general is scrutinizing the private stock-trading venues run by Goldman Sachs Group Inc., Barclays PLC, Credit Suisse Group AG and others as part of a probe into whether high-frequency-trading firms have enjoyed unfair advantages over other investors, people familiar with the matter said. The banks have received requests for information from New York Attorney General Eric Schneiderman's office, which is investigating whether high-speed firms made secret arrangements with exchanges and other venues that allow them to gain an edge, the people said."

Citigroup (Lavaflow) – July 25, 2014

Nature of Violation: Failed to protect customer trade information

New York Times on July 25, 2014: "S.E.C. Says Citigroup Unit Failed to Protect Customer Trading Data." By William Alden

"LavaFlow, a unit of Citigroup that operates an alternative stock trading venue, agreed to pay $5 million to settle charges that it failed to protect the confidential trading data of its customers, the Securities and Exchange Commission said on Friday. The payment includes a $2.85 million penalty that the S.E.C. said was the largest it had levied against an alternative trading system."

UBS – July 29, 2014

Nature of Violation: Misled investors about the role of HFTs in trading

Money.cnn.com on July 29, 2014: "More Banks Caught up in 'Dark Pools' Probe." By Alanna Petroff.

"UBS said Tuesday it is being probed over its alternative off-exchange marketplace, where orders are not made public until they are completed. The Swiss bank said it was cooperating with the U.S. Securities and Exchange Commission, the New York Attorney General and the Financial Industry Regulatory Authority in their investigations. The SEC began investigating UBS in early 2012, focusing on some order types and disclosure practices that the bank says it discontinued around the time the probe began. In addition, UBS noted it was among "dozens of defendants, including broker dealers, trading exchanges, high frequency trading firms, and dark pool sponsors" that could be facing a class action suit filed by traders in a New York federal court."

Deutsche Bank – July 29, 2014

Nature of Violation: Failed to disclose information about dark pool routing

New York Times on July 29, 2014: "UBS and Deutsche Bank Disclose New Inquiries Over 'Dark Pools.'" By Chad Bray

"The long reach of the New York attorney general's office appears to be stretching further into Europe. On Tuesday, the Swiss bank UBS and Deutsche Bank of Germany became the latest banks to disclose that they were facing inquiries from regulators after Attorney General Eric T. Schneiderman of New York sued the British bank Barclays last month over its private stock trading platform, known as a dark pool."

Internet Appendix Table IA.1 – Continued

ITG – July 29, 2015

Nature of Violation: Failed to disclose role of subsidiary in trading

Reuters.com on July 29, 2015. "ITG Sets Aside $20.3 Million Related to Dark Pool Investigation." By John McCrank

"Broker dealer Investment Technology Group said on Wednesday it set aside $20.3 million for a probable settlement with the U.S. Securities and Exchange Commission over rule violations related to its private stock trading venue. The settlement would be a record amount handed out by the SEC related to the operation of a private stock trading platform, or "dark pool." ITG said the SEC was investigating a test program one of the firm's subsidiaries ran from 2010 until mid-2011 that involved proprietary trading inside of ITG's POSIT dark pool against some of its broker clients that the firm did not disclose."

Yahoo.com on July 30, 2015. "ITG Shares Plunge on Likely Dark Pool Settlement with Regulators." By Staff

"Shares of brokerage Investment Technology Group (ITG.N) were down more than 20 percent on Thursday after the company said it had set aside $20.3 million for a probable settlement with regulators related to how it ran its 'dark pool.' ITG disclosed late on Wednesday that the U.S. Securities and Exchange Commission was investigating the lack of disclosure by the firm to its clients that a subsidiary of the agency broker was trading against client orders within ITG's private stock trading venue, or 'dark pool.'"

ITG – August 8, 2018

Nature of Violation: Failed to protect customer trade information

Reuters.com on August 8, 2018. "ITG sets aside $12 million for SEC probe into its U.S. dark pool." By John McCrank

"Agency brokerage Investment Technology Group Inc. ITG.N said on Wednesday it had set aside $12 million for a probable settlement related to a regulatory probe into its U.S. "dark pool," or private stock trading venue. The settlement would be the company's second in recent years with the U.S. Securities and Exchange Commission involving its U.S. POSIT dark pool, following a $20.3 million charge in August 2015. Dark pools allow institutional investors to anonymously trade large blocks of shares without the market moving against them. Over the years the trading venues have evolved to cater to other types of investors and regulatory scrutiny has increased as volumes have grown. The current SEC probe into ITG is focused on several alleged regulatory violations related to disclosures on how its dark pool operated, the underlying technology, and how its data was used, the New York-based company said in a statement."

Citigroup (CORE) – September 14, 2018

Nature of Violation: Misled investors about the role of HFTs in trading

New York Times on September 14, 2018: "Citigroup to Pay $12 Million Over Accusations It Misled Trading Customers." By Emily Flitter.

"Citigroup agreed to pay more than $12 million to settle a regulator's claims that it misled investors who thought they were paying a premium to keep their trading activity shielded from interference by high-frequency traders, the Securities and Exchange Commission has announced. In a civil action filed Friday, the S.E.C. said Citigroup had let two high-frequency trading entities have access to a trading venue called Citi Match, which it had billed as a safe space free of rapid-fire, computer-driven traders. The agency said the presence of the high-frequency traders might have translated into higher prices paid by its other customers. The S.E.C. said Citigroup had failed to tell its customers about the high-frequency traders and, for more than two years, had sometimes routed their trades to venues other than Citi Match without notifying them."

Internet Appendix Table IA.2: Primary Regression Results Excluding Individual Dark Pool Brokers

The table provides results from a linear probability model for the likelihood of downgrade. In each column, we repeat the primary regression results in column (6) of Table 7, excluding one of the sample brokers involved in a dark pool scandal. Results for mutual funds are reported in Panel A and results for pension funds are reported in Panel B. The dependent variable, *Downgrade*, is a binary variable that takes a value of one if the broker is lower on the league table of a fund in a given year than in the previous year and zero otherwise. *Post* is a binary variable that takes a value of one for all post-event years of a fund-broker pair when the broker is involved in a scandal event and zero otherwise. *Post* is equal to zero for all unaffected fund-broker pairs. *High-Fine* is a binary variable that takes a value of one for all brokers involved in reputation shock events that led to fines and disgorgement of more than $40 million and zero otherwise. *Execution-Only* is a binary variable that takes a value of one for execution-only brokers involved in reputation shock events and zero otherwise. Fixed effects are included as reported. *t*-statistics based on standard errors clustered at the broker and fund levels are reported in parentheses. *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively. Commission league tables are collected for mutual funds from annual NSAR and NCEN filings and for pension funds from Comprehensive Annual Financial Reports (CAFRs). The samples include all fund-broker-year observations for which change in broker rank could be defined and fixed effects could be estimated. Detailed definitions of all variables are provided in Appendix II of the paper.

Panel A: Mutual Funds										
Excluding	Barclays	Citigroup	Credit Suisse	Deutsche Bank	Goldman Sachs	UBS	ITG	KCG	Liquidnet	Pipeline
	(1)	(2)	(3)	(4)	(5)	(10)	(6)	(7)	(8)	(9)
Post × High-Fine	0.079***	0.116***	0.108***	0.100***	0.088**	0.080***	0.096***	0.095***	0.095***	0.095***
	(3.63)	(6.09)	(4.11)	(3.49)	(2.58)	(2.96)	(3.82)	(3.90)	(3.77)	(3.83)
Post × Execution-Only	0.119*	0.141**	0.119*	0.120*	0.120	0.107*	0.198***	0.052	0.134	0.116*
	(1.85)	(2.17)	(1.95)	(1.94)	(1.65)	(1.75)	(2.94)	(1.36)	(1.43)	(1.81)
Post	0.006	-0.019	0.002	0.003	0.009	0.020	0.004	0.006	0.002	0.004
	(0.21)	(-0.67)	(0.08)	(0.10)	(0.24)	(0.63)	(0.14)	(0.18)	(0.05)	(0.13)
Broker Rank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Broker × Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,273	30,830	30,947	31,433	30,720	31,201	32,514	32,635	32,439	32,948
Adjusted R^2	0.254	0.259	0.259	0.253	0.262	0.257	0.256	0.256	0.257	0.256

Internet Appendix Table IA.2 - Continued

	Panel B: Pension Funds									
Excluding	Barclay	Citigroup	Credit Suisse	Deutsche Bank	Goldman Sachs	UBS	ITG	KCG	Liquidnet	Pipeline
	(1)	(2)	(3)	(4)	(5)	(10)	(6)	(7)	(8)	(9)
Post × High-Fine	0.210***	0.210***	0.239***	0.156***	0.172***	0.221***	0.204***	0.202***	0.204***	0.203***
	(3.34)	(3.90)	(5.23)	(4.52)	(4.30)	(4.35)	(4.25)	(4.21)	(4.26)	(4.21)
Post × Execution-Only	0.170***	0.178***	0.171***	0.169***	0.142***	0.190***	0.136***	0.190***	0.177***	0.171***
	(4.15)	(3.87)	(4.17)	(4.04)	(4.07)	(4.28)	(2.77)	(5.30)	(4.12)	(4.12)
Post	-0.049*	-0.055	-0.047	-0.046	-0.018	-0.063*	-0.048*	-0.048	-0.049*	-0.047
	(-1.70)	(-1.55)	(-1.65)	(-1.62)	(-1.23)	(-1.94)	(-1.67)	(-1.66)	(-1.71)	(-1.65)
Broker Rank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Broker × Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	33,888	33,814	33,794	33,861	33,799	33,805	33,959	34,269	34,023	34,496
Adjusted R^2	0.205	0.205	0.206	0.205	0.206	0.205	0.205	0.204	0.205	0.203

Internet Appendix Table IA.3: Description of Sample Pension Funds

The table describes the 77 pension funds in the final sample. Commission data for these funds are collected from the Comprehensive Annual Financial Report (CAFR). The number of brokers reported in the table is after aggregation of broker names.

State	Fund Name	Reporting Month	Years in Data	Min # brokers	Max # brokers	Min Annual Commission ($millions)	Max Annual Commission ($millions)
Alabama	Retirement Systems of Alabama	9	11	24	39	0.20	7.62
Arizona	Arizona Public Safety Personnel Retirement System	6	11	17	100	0.09	0.95
	Arizona State Retirement System	6	11	16	60	1.35	6.65
	City of Phoenix, Arizona Employees Retirement Plan	6	11	3	25	0.16	0.70
	Tucson Supplemental Retirement System	6	11	15	36	0.07	0.44
Arkansas	Arkansas Public Employees Retirement System	6	11	20	25	2.00	4.79
California	California Public Employees Retirement System (CALPERS)	6	11	44	158	28.37	50.43
	California State Teachers Retirement System (CALSTERS)	6	11	10	10	19.37	35.45
	Alameda County Employees' Retirement Association	12	11	18	20	1.00	2.88
	City of Fresno Employees Retirement System	6	11	7	10	0.26	0.81
	City of San Jose Federated City Employees Retirement System	6	11	66	128	0.13	1.24
	Los Angeles City Employees Retirement System (LACERS)	6	11	7	10	3.16	6.26
	Orange County Employees Retirement System	12	11	16	37	0.33	1.95
	Sacramento County Employees Retirement System	6	11	13	22	0.67	2.45
	San Bernardino County Employees Retirement Association	6	9	2	9	0.00	1.47
	San Diego City Employees Retirement System	6	11	23	25	0.30	5.58
	San Diego County Employees Retirement Association	6	11	8	18	0.30	4.62
Colorado	Fire & Police Association of Colorado	12	11	26	49	0.43	1.17
	Denver Employees Retirement Plan	12	11	24	69	0.12	0.53
Connecticut	Connecticut Combined Investment Funds	6	11	160	329	5.31	14.39
Delaware	Delaware Public Employees Retirement System	6	11	13	34	0.59	2.23
Hawaii	Employees Retirement System of the State of Hawaii	6	11	22	139	2.18	5.20
Idaho	Public Employee Retirement System of Idaho	6	11	14	25	2.37	5.49
Illinois	Illinois Municipal Retirement Fund	12	11	32	46	6.03	11.92
	Illinois State Board of Investment	6	11	13	64	0.24	3.92
	State Universities Retirement System of Illinois	6	11	57	267	2.94	5.12
	Teachers Retirement System of the State of Illinois	6	11	47	50	5.55	23.16
	Chicago Teachers Pension Fund	6	11	44	68	2.40	7.49
	County Empl. and Officers Annuity & Benefit Fund of Cook Co.	12	11	19	36	1.52	3.19
	Forest Preserve District Empl. Annuity & Benefit Fund of Cook Co.	12	10	14	22	0.03	0.09
	Municipal Employees Annuity and Benefit Fund of Chicago	12	11	18	71	0.77	1.96
	Policemen's Annuity and Benefit Fund of Chicago	12	11	22	40	0.65	2.08

| State	Fund Name	Reporting Month	Years in Data	Min # brokers	Max # brokers	Min Annual Commission ($millions)	Max Annual Commission ($millions)
Indiana	Indiana Public Retirement System	6	11	8	11	3.46	6.48
Iowa	Iowa Public Employees Retirement System	6	11	22	25	2.88	6.36
Kansas	Kansas Public Employees Retirement System	6	11	11	31	0.40	3.13
	Wichita Retirement Systems	12	11	16	64	0.32	0.50
Kentucky	Teachers Retirement System of the State of Kentucky	6	11	56	94	1.27	3.22
Louisiana	Louisiana State Employees' Retirement System	6	11	24	70	0.92	2.72
Maine	Maine Public Employees Retirement System	6	11	9	14	0.03	1.90
Maryland	Maryland State Retirement and Pension System	6	11	13	29	5.39	16.40
	Baltimore Fire and Police Employees Retirement System	6	11	26	30	0.48	1.07
	Montgomery County Employee Retirement Plans	6	11	8	12	0.24	0.86
Massachusetts	Massachusetts Pension Reserve Investment Trust	6	11	23	25	5.81	11.43
Michigan	Michigan Public School Employees Retirement System	9	11	13	29	1.64	8.41
	Michigan State Employees Retirement System	9	11	13	29	0.43	2.07
Minnesota	Minnesota State Board of Investment	6	11	155	309	7.09	24.61
Mississippi	Public Employees Retirement System of Mississippi	6	11	19	31	4.23	10.45
Missouri	Missouri Dept. of Transportation & Patrol Employees Retirement Syst.	6	11	21	35	0.11	0.26
	Missouri Local Government Employee Retirement System	6	10	13	39	0.99	3.17
	Missouri Public School & Education Employee Retirement Systems	6	11	13	21	5.07	13.91
Nevada	Public Employees Retirement System of Nevada	6	11	24	83	0.18	4.24
New Hampshire	New Hampshire Retirement System	6	11	16	19	1.38	2.34
New Jersey	New Jersey Division of Pensions and Benefits	6	11	10	53	3.57	20.74
New York	New York State and Local Retirement System	3	11	204	245	18.07	29.30
North Dakota	North Dakota Retirement and Investment	6	11	6	10	0.73	1.54
Ohio	Ohio Police & Fire Pension Funds	12	10	18	33	1.80	4.00
	Ohio Public Employees Retirement System	12	11	33	75	6.23	31.92
	School Employees Retirement System of Ohio	6	11	40	49	0.53	2.38
Oklahoma	Oklahoma Police Pension and Retirement System	6	11	16	79	0.14	1.17
	Oklahoma Public Employees Retirement System	6	11	15	20	1.17	1.73
	Oklahoma City Employees Retirement System	6	11	14	21	0.05	1.98
	Tulsa County Employees Retirement System	6	11	4	5	0.04	0.13
Oregon	Oregon Public Employee Retirement System	6	11	18	20	6.99	20.73
Pennsylvania	Pennsylvania Public Employee Retirement System	12	11	21	39	1.90	5.10
	Pennsylvania State Employee Retirement System	6	11	13	26	4.00	17.70
South Carolina	South Carolina Public Employee Retirement System	6	11	9	20	4.26	7.07

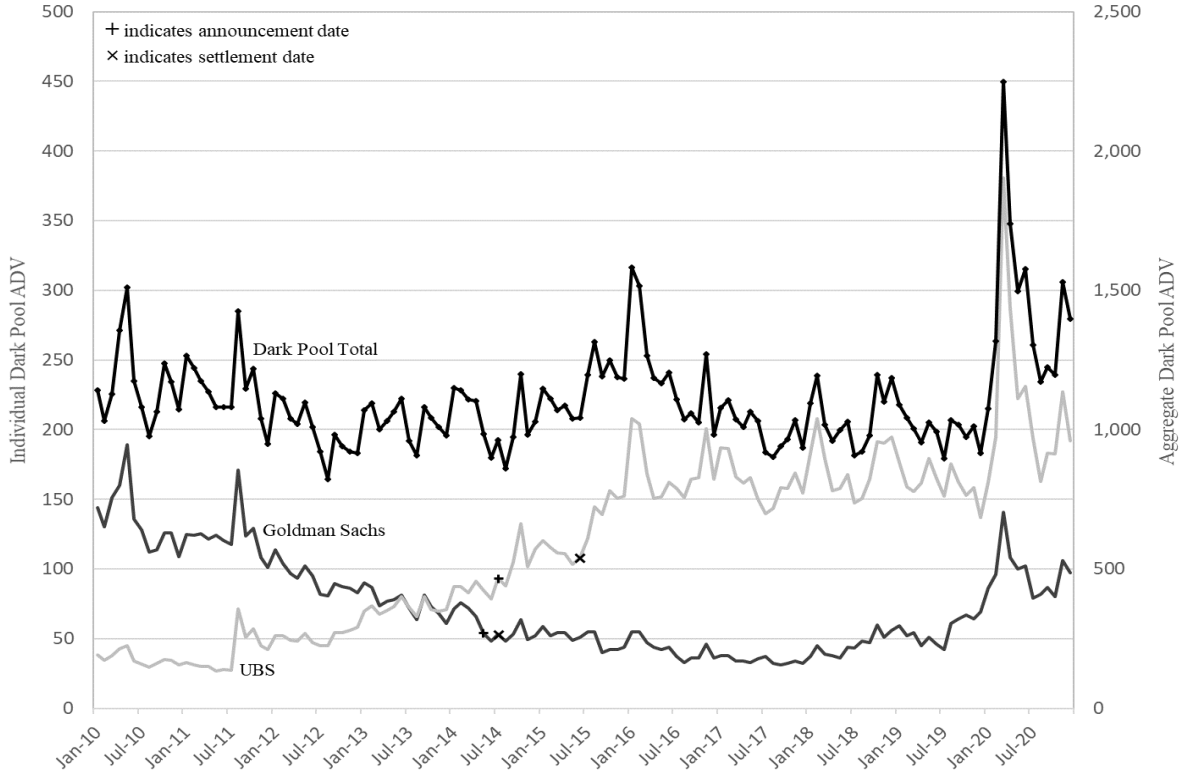## Internet Appendix Table IA.3 – Continued

State	Fund Name	Reporting Month	Years in Data	Min # brokers	Max # brokers	Min Annual Commission ($millions)	Max Annual Commission ($millions)
Tennessee	Tennessee Consolidated Retirement System	6	11	18	26	10.24	18.46
Texas	Texas County and District Retirement System	12	11	10	16	0.75	1.69
	Texas Teachers Retirement System	8	11	10	312	50.27	66.70
	Austin Employee Retirement System	12	11	9	27	0.16	0.97
	Fort Worth Employees Retirement Fund	9	11	34	71	0.27	0.79
	Houston Municipal Employees Pension System	6	11	34	66	0.33	1.12
	Houston Police Officers Pension System	6	10	1	16	0.00	0.59
	Texas Employee Retirement System	8	9	45	55	5.62	11.18
Utah	Utah Public Employee Retirement System	12	11	9	22	2.45	5.79
Virginia	Virginia Retirement System	6	11	8	21	7.01	21.93
Washington	Washington State Department of Retirement Systems	6	11	56	203	4.25	11.79

**Panel A – Full-Service Brokers involved in High-Fine Events**
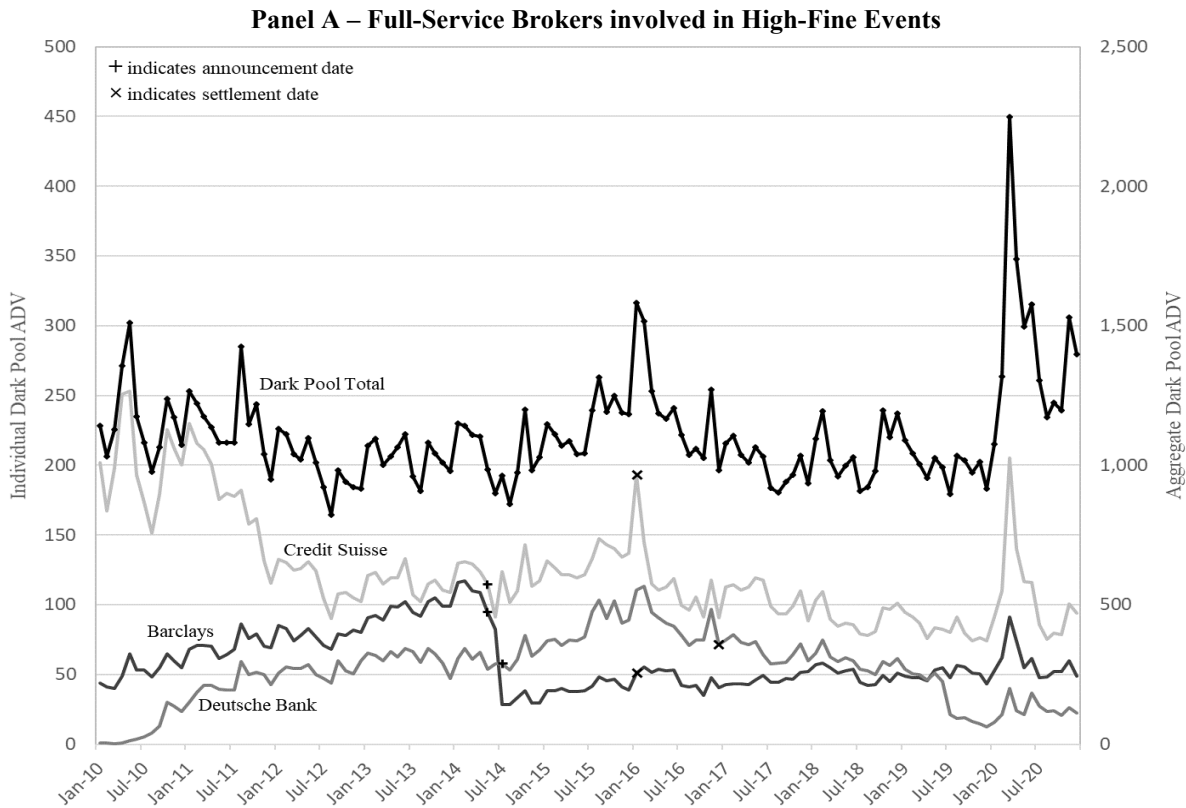
Internet Appendix Figure IA.1 – Monthly Dark Pool Volume around Broker Scandals
The figure plots average daily volume (ADV) by month for broker dark pools affected by scandals (left-hand axis), as well as across all dark pools (right-hand axis). Volumes are in millions of shares. For dark pools operated by full-service brokers, results are provided separately for high-fine events (Panel A) and low-fine events (Panel B), where high-fine events are those resulting in penalties of at least $40 million. Results for dark pools operated by execution-only brokers are provided in Panel C. In addition, the graph indicates the announcement date (+) and settlement date (×) associated with each dark pool scandal. Event descriptions and broker classifications are provided in Table 1 of the paper and additional information on the determination of announcement dates is provided in Internet Appendix Table IA.1. The monthly data are provided by Rosenblatt Securities. KCG and Citigroup dark pools are omitted due lack of available data.

Panel B – Full-Service Brokers involved in Low-Fine Events

Panel C – Execution-Only Brokers
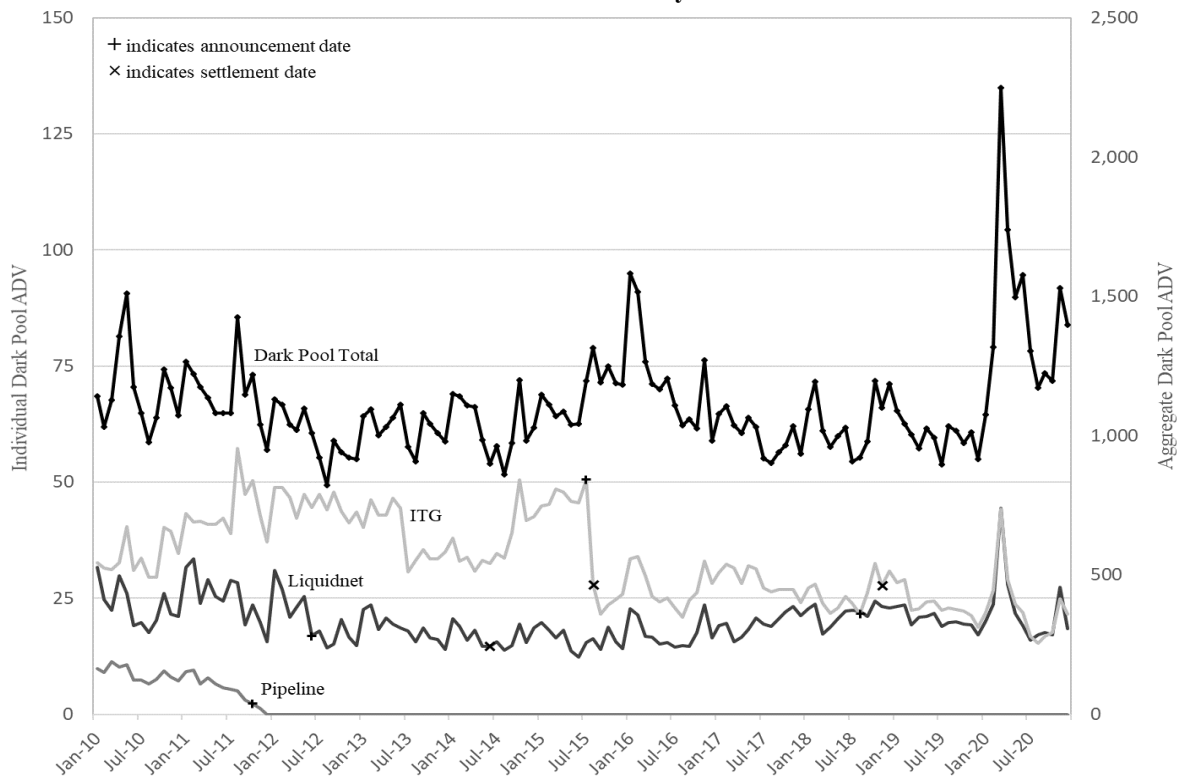
Internet Appendix Figure IA.1 – Continued