

Internet Appendix for *Bulk Volume Classification and Information Detection*
(Panayides, Shohfi, and Smith) July 2018

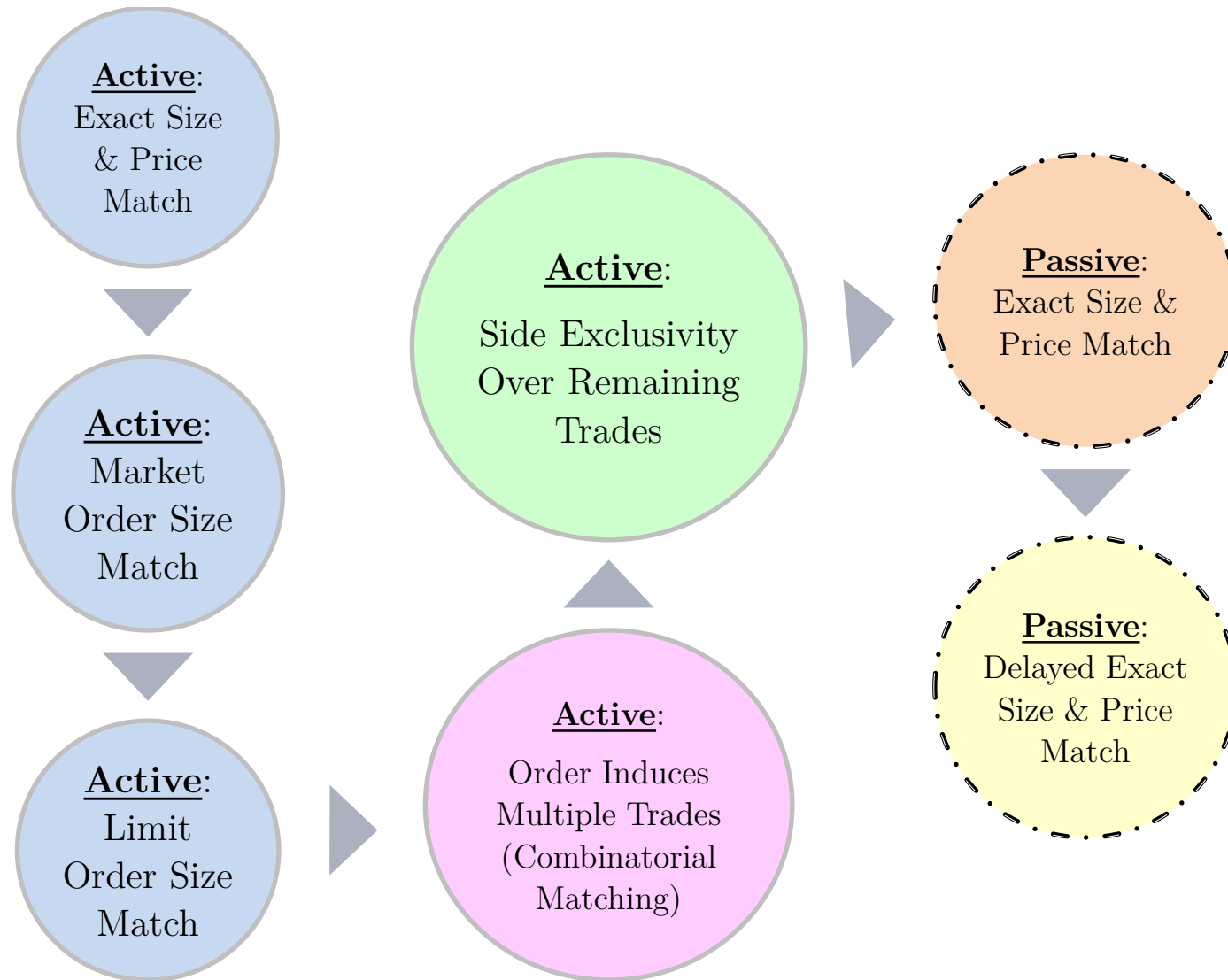
List of Sample Firms

ISIN	Firm Name	ISIN	Firm Name	ISIN	Firm Name
FR0000031023	Électricite de Strasbourg Société Anonyme	FR0000184814	FUTUREN SA	GB0009692319	Wilmington plc
FR0000031122	Air France-KLM SA	FR0004023208	Les Nouveaux Constructeurs SA	GB0009697037	Babcock International Group plc
FR0000031577	Virbac SA	FR0004024222	Interparfums SA	GB0009895292	AstraZeneca PLC
FR0000031775	Vicat SA	FR0004025062	Soitec S.A.	GB0030646508	GKN plc
FR0000033318	Societe Sucriere de Pithiviers-le-Vieil	FR0004035913	Iliad SA	GB0030913577	BT Group plc
FR0000034548	Union Financiere de France Banque SA	FR0004038263	Parrot S.A.	GB0031215220	Carnival plc
FR0000034639	Altran Technologies S.A.	FR0004045540	SQLi	GB0031274896	Marks and Spencer Group plc
FR0000035743	Etam Developpement SCA	FR0004050250	Neurones S.A.	GB0031348658	Barclays PLC
FR0000036105	Affine	FR0004054427	Diaxonhit	GB0031638363	Intertek Group plc
FR0000036303	Lucia SA	FR0004180537	AKKA Technologies SE	GB0031743007	Burberry Group plc
FR0000036675	Groupe CRIT SA	FR0004548873	Bourbon Corporation SA	GB0031809436	Land Securities Group plc
FR0000038606	Manitou BF SA	FR0005025004	Crédit Industriel et Commercial	GB0032089863	NEXT plc
FR0000039091	Robertet SA	FR0010040865	Gecina	GB0033195214	Kingfisher plc
FR0000039299	Bollore	FR0010096354	Solocal Group S.A.	GB0033764746	French Connection Group PLC
FR0000039620	Mersen S.A.	FR0010096479	bioMérieux S.A.	GB0033986497	ITV plc
FR0000044547	Caisse Régionale de Crédit Agricole Mutuel d'Aquitaine	FR0010220475	Alstom SA	GB0034291418	Centaur Media Plc
FR0000045072	Crédit Agricole S.A.	FR0010240994	NextRadioTV SA	GB00B015PT76	Altyn Plc
FR0000045213	Caisse Régionale De Crédit Agricole Mutuel D'ille-Et-Vilaine	FR0010242511	Electricité de France S.A.	GB00B019KW72	J Sainsbury plc
FR0000045528	Caisse Régionale de Crédit Agricole Mutuel de Paris et d'Ile-de-France	FR0010259150	Ipsen S.A.	GB00B01C3S32	Randgold Resources Limited
FR0000051807	Teleperformance SE	FR0010282822	SES-imagotag	GB00B01DW905	e2v Technologies plc
FR0000053142	Faiveley Transport S.A.	FR0010294595	Seloger.com SA	GB00B01FLG62	G4S plc
FR0000054231	High Co. SA	FR0010309096	CeGeREAL	GB00B02J6398	Admiral Group plc
FR0000054900	Télévision Française 1 SA	FR0010324962	Celeos SA	GB00B033F229	Centrica plc
FR0000060402	Albioma	FR0010331421	Innate Pharma S.A.	GB00B0744B38	Bunzl plc
FR0000064784	FFP Société anonyme	FR0010411983	SCOR SE	GB00B082RF11	Rentokil Initial plc

ISIN	Firm Name	ISIN	Firm Name	ISIN	Firm Name
FR0000066177	Compagnie La Lucette	GB0000456144	Antofagasta plc	GB00B08SNH34	National Grid plc
FR0000071946	Alten SA	GB0000533728	Laura Ashley Holdings plc	GB00B0SWJX34	London Stock Exchange Group plc
FR0000073041	Pierre & Vacances SA	GB0000536739	Ashtead Group plc	GB00B10RZP78	Unilever PLC
FR0000073793	Devoteam SA	GB0000566504	BHP Billiton plc	GB00B12MHD28	LMS Capital plc
FR0000074759	Fleury Michon SA	GB0000600931	Braemar Shipping Services plc	GB00B1CRLC47	Mondi plc
FR0000074783	Artprice.com	GB0000608009	WS Atkins plc	GB00B1FH8J72	Severn Trent Plc
FR0000075988	AdUX SA	GB0000811801	Barratt Developments plc	GB00B1KJJ408	Whitbread PLC
FR0000076192	BCI Navigation S.A.	GB0001195089	Brammer plc	GB00B1VS7G47	The Local Shopping REIT plc
FR0000120073	L'Air Liquide S.A.	GB0001367019	British Land Company Plc	GB00B1VZ0M25	Hargreaves Lansdown plc
FR0000120172	Carrefour SA	GB0001411924	Sky plc	GB00B1WY2338	Smiths Group plc
FR0000120271	TOTAL S.A.	GB0001713154	Candover Investments plc	GB00B1XZS820	Anglo American plc
FR0000120289	Guyenne et Gascogne SA	GB0001795680	Castings P.L.C.	GB00B1YW4409	3i Group plc
FR0000120321	L'Oréal S.A.	GB0001979029	Management Consulting Group PLC	GB00B1Z4ST84	Provident Financial plc
FR0000120354	Vallourec SA	GB0002015021	TClarke plc	GB00B1ZBLD47	Sepura plc
FR0000120404	Accor SA	GB0002162385	Aviva plc	GB00B24CGK77	Reckitt Benckiser Group plc
FR0000120503	Bouygues SA	GB0002349065	R.E.A. Holdings plc	GB00B2B0DG97	RELX PLC
FR0000120529	ENGIE SA	GB0002374006	Diageo plc	GB00B2QPKJ12	Fresnillo PLC
FR0000120537	Lafarge S.A.	GB0002405495	Schroders plc	GB00B39J2M42	United Utilities Group PLC
FR0000120560	Neopost S.A.	GB0002634946	BAE Systems plc	GB00B4QMVR10	Flybe Group PLC
FR0000120644	Danone SA	GB0002875804	British American Tobacco p.l.c.	GB00B5ZN1N88	SEGRO Plc
FR0000120685	Natixis S.A.	GB0002922382	Torotrak plc	GB00B63H8491	Rolls-Royce Holdings plc
FR0000120693	Pernod Ricard SA	GB0004065016	Hammerson plc	GB00B6TKHP66	Secure Trust Bank Plc
FR0000120966	Société BIC SA	GB0004082847	Standard Chartered PLC	GB00B77J0862	Old Mutual plc
FR0000121220	Sodexo S.A.	GB0004544929	Imperial Brands PLC	GB00B7KR2P84	easyJet plc

ISIN	Firm Name	ISIN	Firm Name	ISIN	Firm Name
FR0000121329	Thales S.A.	GB0005057541	Lavendon Group plc	GB00B7T77214	The Royal Bank of Scotland Group plc
FR0000121485	Kering SA	GB0005405286	HSBC Holdings plc	GB00B8C3BL03	The Sage Group plc
FR0000121501	Peugeot S.A.	GB0005603997	Legal & General Group Plc	GB00B8HX8Z88	Mediclinic International plc
FR0000121568	Club Méditerranée	GB0005776561	Dunedin Enterprise Investment Trust PLC	GB00BD3VFW73	Convatec Group Plc
FR0000121691	NRJ Group SA	GB0006043169	Wm Morrison Supermarkets PLC	GB00BD736828	Air Partner plc
FR0000121709	SEB SA	GB0006081037	Mountview Estates P.L.C.	GB00BDVZY77	Royal Mail plc
FR0000121725	Dassault Aviation SA	GB0006091408	A & J Mucklow Group Plc	GB00BDZT6P94	Merlin Entertainments plc
FR0000121881	Havas SA	GB0006556046	Charles Stanley Group plc	GB00BH4HKS39	Vodafone Group Plc
FR0000121972	Schneider Electric S.E.	GB0006731235	Associated British Foods plc	GB00BJT0FF39	RM plc
FR0000124141	Veolia Environnement S.A.	GB0006776081	Pearson plc	GB00BKKMKR23	RSA Insurance Group plc
FR0000124356	SALVEPAR	GB0006825383	Persimmon Plc	GB00BKY7HG11	Exova Group plc
FR0000124414	Gascogne SA	GB0007099541	Prudential plc	GB00BLNN3L44	Compass Group PLC
FR0000124570	Compagnie Plastic Omnium SA	GB0007188757	Rio Tinto plc	GB00BLZH7X42	River and Mercantile Group PLC
FR0000124711	Unibail-Rodamco SE	GB0007669376	St. James's Place plc	GB00BMJ6DW54	Informa plc
FR0000125338	Capgemini SE	GB0007689002	St Ives plc	GB00BMP36W19	GAME Digital plc
FR0000125346	Ingenico Group - GCS	GB0007892358	Sole Realisation Company plc	GB00BPXRVT80	Punch Taverns Limited
FR0000125585	Casino, Guichard-Perrachon Société Anonyme	GB0007908733	SSE plc	GB00BQY7BX88	Micro Focus International plc
FR0000127771	Vivendi SA	GB0007980591	BP p.l.c.	GB00BRK8Y334	Johnston Press plc
FR0000130213	Lagardère SCA	GB0008052507	Shires Income Plc	GB00BVDPV41	Revolution Bars Group plc
FR0000130403	Christian Dior SE	GB0008706128	Lloyds Banking Group plc	GB00BVFD7Q58	Standard Life Aberdeen plc
FR0000130452	Eiffage SA	GB0008782301	Taylor Wimpey plc	GB00BWDPMF43	Shawbrook Group plc
FR0000130577	Publicis Groupe S.A.	GB0008847096	Tesco PLC	GB00BY9D0Y18	Direct Line Insurance Group plc
FR0000130809	Société Générale Société anonyme	GB0009223206	Smith & Nephew plc	GB00BYXK6398	InterContinental Hotels Group PLC
FR0000131757	ERAMET S.A.	GB0009252882	GlaxoSmithKline plc	GB00BYYK2V80	Worldpay Group plc
FR0000131906	Renault SA	GB0009296665	The Vitec Group plc	GB00BYZWX769	Croda International Plc
FR0000184798	ORPEA Société Anonyme	GB0009390070	Volex plc	GB00BZ4BQC70	Johnson Matthey Plc

Illustration of Trade Aggressor/Initiator Identification Process



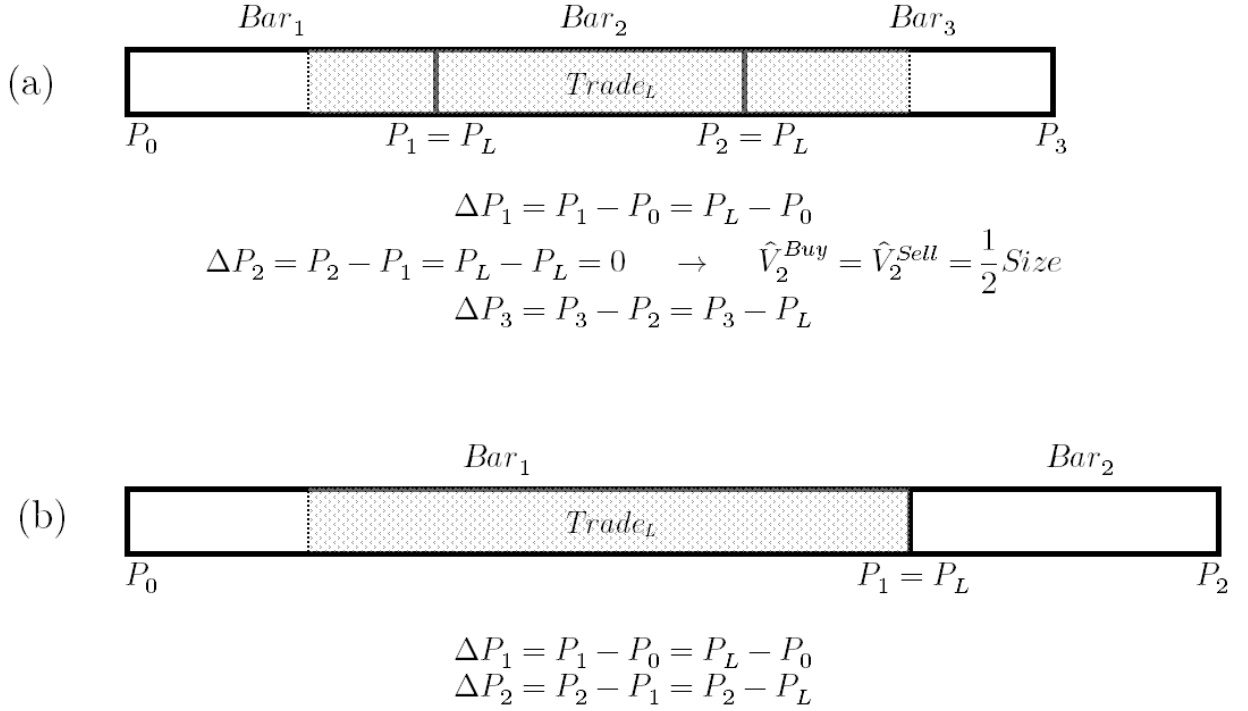


Figure 3

The illustrations above demonstrate how using truncated bar sizes can create a systematic bias in the BVC's volume bar accuracy. Bars are separated by thick black lines and labeled accordingly. Consider a large trade $Trade_L$ (represented by the shaded area) that is larger than the specified volume bar size and is initiated by a buyer (seller) which moves the price P_L up (down) from the previous bar's price P_0 . Illustration (a) indicates that using truncated volume bar sizes will incorrectly classify Bar_2 as being made up of half buy volume and half sell volume. In illustration (b), the use of minimum specified bar size prevents $Trade_L$ from being split across bars. By allowing the bar size to extend beyond the minimum, Bar_1 includes all of the volume in $Trade_L$. In this case, the bias is corrected and the contribution to price change by $Trade_L$ will be applied to its entire volume.

Table 8A

Spread Regressions on Order Imbalance – Index Membership Subsamples

This table displays the regression results from the regression $Spread_{\tau} = \alpha_0 + \alpha_1[Spread_{\tau-1}] + \gamma|\widehat{OI}_{\tau}| + \varepsilon_{\tau}$, with the addition of firm and month fixed effects. Please see the text for variable definitions. We measure within-bar order imbalance using the BVC, the bulk tick, and the trade aggressor, which is known in our data. Each Panel uses a different spread measure: Panel A displays results using the Corwin and Schultz (2012) estimator, Panel B uses the volume-weighted effective spread in the bar, and Panel C uses a simple high-low trading range in the bar. We display the order imbalance coefficient and its t -statistic for each spread measure and each imbalance measure. The regressions are further split by whether the stock had any options trading data in Bloomberg in our sample windows. Standard errors are clustered by firm. The aggregated coefficients are weighted by the reciprocal of the squared standard error for each regression specification and the aggregate standard errors are corrected using the method from [Chordia et al. \(2000\)](#).

	BVC OI estimate				Tick OI estimate				Aggressor OI			
	Options market		No options		Options market		No options		Options market		No options	
	Coef(γ)	t(γ)	Coef(γ)	t(γ)	Coef(γ)	t(γ)	Coef(γ)	t(γ)	Coef(γ)	t(γ)	Coef(γ)	t(γ)
<i>Panel A: Corwin-Schultz estimator</i>												
1,000	0.016	2.73	0.011	1.44	0.004	3.88	0.005	2.67	0.003	4.12	0.003	2.77
5,000	0.028	3.00	0.028	2.25	0.004	3.82	0.004	2.90	0.002	3.62	0.003	3.38
10,000	0.033	2.89	0.027	2.15	0.003	3.20	0.002	2.09	0.002	3.15	0.002	3.27
50,000	0.030	2.86	0.025	2.40	-0.001	-1.13	-0.002	-0.89	-0.001	-1.86	-0.001	-0.44
100,000	0.025	2.74	0.022	1.94	-0.002	-1.47	-0.003	-0.90	-0.004	-1.89	-0.001	-0.47
Mean effect	0.023	2.96	0.020	2.16	0.002	1.87	0.002	1.69	0.001	1.85	0.002	2.46
<i>Panel B: Effective spread</i>												
1,000	0.079	2.97	1.028	2.02	-0.008	-3.13	-0.040	-1.40	-0.008	-2.67	-0.132	-2.69
5,000	0.061	3.24	3.350	1.44	-0.006	-3.31	-0.108	-1.49	-0.003	-2.09	-0.106	-2.12
10,000	0.055	3.10	1.949	2.18	-0.005	-3.03	-0.332	-1.49	-0.002	-2.15	-0.307	-1.42
50,000	0.032	3.07	1.299	1.78	-0.001	-1.64	-0.166	-1.51	-0.001	-1.25	-0.176	-1.94
100,000	0.043	1.95	0.379	1.86	0.000	0.22	-0.164	-1.69	0.000	0.24	-0.227	-1.73
Mean effect	0.045	2.29	0.595	1.12	-0.002	-1.25	-0.066	-0.90	-0.002	-1.13	-0.136	-1.46
<i>Panel C: High-low range</i>												
1,000	0.060	3.36	0.153	3.34	-0.011	-4.44	-0.022	-4.03	-0.004	-3.19	-0.008	-2.80
5,000	0.103	3.28	0.278	3.55	-0.014	-4.02	-0.038	-3.71	-0.005	-3.00	-0.020	-2.97
10,000	0.103	3.32	0.285	3.72	-0.015	-3.81	-0.058	-3.72	-0.008	-3.50	-0.043	-3.37
50,000	0.071	3.72	0.259	3.90	-0.018	-2.53	-0.095	-3.23	-0.018	-2.41	-0.092	-3.13
100,000	0.058	3.19	0.250	3.48	-0.023	-2.24	-0.118	-3.08	-0.025	-2.19	-0.127	-3.23
Mean effect	0.070	2.80	0.223	2.78	-0.013	-2.95	-0.031	-2.45	-0.005	-2.23	-0.012	-1.70