

Appendix

Supplementary material for

“Withholding-Tax Non-Compliance: The Case of Cum-Ex Stock-Market Transactions”

by

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Table A1
Descriptive statistics

	Cum-ex period 2009 - 2011		Post period 2012 - 2015	
	Taxable	Tax-exempt	Taxable	Tax-exempt
Number of dividend payments	289	50	408	82
Absolute dividend (per stock)*				
Mean (in euros)	1.41	0.36	1.53	0.58
Standard deviation	1.98	0.28	1.89	0.59
Dividend yield*				
Mean (in %)	2.83	3.57	2.55	3.33
Standard deviation	1.82	2.00	1.80	2.01
Market capitalization*				
Mean (in million euros)	5,391.40	3,054.59	7,239.99	4,170.24
Standard deviation	11,577.11	7,176.06	14,850.30	8,282.68

Note: descriptive statistics for the cum-ex period from 2009 to 2011 and the post period from 2012 to 2015, shown separately. We distinguish stocks by source of dividend payment. Dividends from current profits are subject to withholding tax (taxable dividend) and, therefore, suitable for cum-ex trading. Dividends from capital reserves are withholding-tax exempt and, thus, not suitable for cum-ex trading. * : missing values encountered.

Table A2**Regression results: number of stocks traded around ex-dividend date**

	(1)	(2)	(3)	(4)	(5)
Cum-ex effects					
$D_{i,-2} * I_i * T_i$	0.487 (0.30)	0.256* (0.15)	0.258* (0.16)	0.258* (0.16)	0.253 (0.15)
$D_{i,-1} * I_i * T_i$	0.238 (0.15)	0.324*** (0.11)	0.324*** (0.11)	0.324*** (0.11)	0.316*** (0.11)
Days before/after ex-dividend date					
$D_{i,-10}$	-0.035 (0.08)	0.037 (0.06)	0.037 (0.06)	0.037 (0.06)	0.037 (0.06)
$D_{i,-9}$	0.064 (0.07)	0.046 (0.06)	0.047 (0.06)	0.047 (0.06)	0.046 (0.06)
$D_{i,-8}$	0.138 (0.07)	0.098 (0.07)	0.098 (0.07)	0.098 (0.06)	0.098 (0.06)
$D_{i,-7}$	0.058 (0.06)	0.022 (0.05)	0.022 (0.05)	0.022 (0.05)	0.022 (0.05)
$D_{i,-6}$	0.081 (0.08)	0.036 (0.05)	0.036 (0.05)	0.036 (0.05)	0.036 (0.05)
$D_{i,-5}$	0.056 (0.09)	0.031 (0.07)	0.031 (0.07)	0.031 (0.07)	0.031 (0.07)
$D_{i,-4}$	0.157 (0.09)	0.075 (0.08)	0.075 (0.08)	0.075 (0.08)	0.075 (0.08)
$D_{i,-3}$	0.262*** (0.06)	0.214*** (0.05)	0.214*** (0.05)	0.214*** (0.05)	0.214*** (0.05)
$D_{i,-2}$	0.145** (0.07)	0.167** (0.07)	0.167** (0.07)	0.167** (0.07)	0.167** (0.07)
$D_{i,-1}$	0.258*** (0.06)	0.280*** (0.06)	0.280*** (0.06)	0.280*** (0.06)	0.280*** (0.06)
$D_{i,0}$	0.333*** (0.06)	0.338*** (0.05)	0.338*** (0.05)	0.338*** (0.05)	0.338*** (0.05)
$D_{i,+1}$	0.017 (0.06)	0.022 (0.05)	0.022 (0.05)	0.022 (0.05)	0.022 (0.05)
$D_{i,+2}$	0.073 (0.05)	0.071 (0.05)	0.071 (0.05)	0.071 (0.05)	0.071 (0.05)
$D_{i,+3}$	0.020 (0.08)	-0.004 (0.06)	-0.004 (0.06)	-0.004 (0.06)	-0.004 (0.06)
$D_{i,+4}$	0.009 (0.06)	0.004 (0.06)	0.004 (0.06)	0.004 (0.06)	0.004 (0.06)
$D_{i,+5}$	-0.007 (0.07)	-0.010 (0.05)	-0.010 (0.05)	-0.010 (0.05)	-0.010 (0.05)
$D_{i,+6}$	0.099 (0.08)	0.113 (0.07)	0.113 (0.07)	0.113 (0.07)	0.113 (0.07)
$D_{i,+7}$	-0.109 (0.08)	-0.051 (0.06)	-0.051 (0.06)	-0.051 (0.06)	-0.051 (0.06)
$D_{i,+8}$	0.050 (0.07)	-0.003 (0.06)	-0.003 (0.06)	-0.003 (0.06)	-0.003 (0.06)

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Table A2**Regression results: number of stocks traded around ex-dividend date (*continued*)**

	(1)	(2)	(3)	(4)	(5)
$D_{i,+9}$	0.067 (0.08)	-0.010 (0.07)	-0.010 (0.07)	-0.010 (0.07)	-0.010 (0.07)
$D_{i,+10}$	-0.058 (0.09)	-0.035 (0.06)	-0.035 (0.06)	-0.036 (0.06)	-0.035 (0.06)
Days before/after ex-dividend date – taxable dividends					
$D_{i,-10} * I_i$	0.155 (0.09)	0.101 (0.06)	0.102 (0.06)	0.102 (0.06)	0.102 (0.06)
$D_{i,-9} * I_i$	-0.024 (0.07)	0.033 (0.06)	0.033 (0.06)	0.033 (0.06)	0.033 (0.06)
$D_{i,-8} * I_i$	-0.137 (0.08)	-0.089 (0.07)	-0.089 (0.07)	-0.089 (0.07)	-0.089 (0.07)
$D_{i,-7} * I_i$	-0.065 (0.07)	-0.020 (0.05)	-0.020 (0.05)	-0.020 (0.05)	-0.020 (0.05)
$D_{i,-6} * I_i$	-0.043 (0.08)	0.002 (0.05)	0.002 (0.05)	0.002 (0.05)	0.002 (0.05)
$D_{i,-5} * I_i$	-0.003 (0.10)	0.049 (0.07)	0.049 (0.07)	0.049 (0.07)	0.049 (0.07)
$D_{i,-4} * I_i$	-0.086 (0.10)	0.004 (0.09)	0.003 (0.09)	0.003 (0.09)	0.003 (0.09)
$D_{i,-3} * I_i$	-0.186*** (0.07)	-0.105** (0.05)	-0.105** (0.05)	-0.105** (0.05)	-0.105** (0.05)
$D_{i,-2} * I_i$	0.018 (0.08)	-0.021 (0.07)	-0.021 (0.07)	-0.021 (0.07)	-0.021 (0.07)
$D_{i,-1} * I_i$	0.061 (0.07)	0.054 (0.07)	0.054 (0.07)	0.054 (0.07)	0.054 (0.07)
$D_{i,0} * I_i$	0.020 (0.06)	0.008 (0.05)	0.008 (0.05)	0.008 (0.05)	0.008 (0.05)
$D_{i,+1} * I_i$	0.057 (0.07)	0.042 (0.06)	0.042 (0.06)	0.042 (0.06)	0.042 (0.06)
$D_{i,+2} * I_i$	-0.043 (0.06)	-0.014 (0.05)	-0.014 (0.05)	-0.014 (0.05)	-0.014 (0.05)
$D_{i,+3} * I_i$	0.007 (0.08)	0.035 (0.06)	0.035 (0.06)	0.035 (0.06)	0.035 (0.06)
$D_{i,+4} * I_i$	-0.052 (0.07)	-0.012 (0.06)	-0.012 (0.06)	-0.012 (0.06)	-0.012 (0.06)
$D_{i,+5} * I_i$	-0.007 (0.08)	0.008 (0.05)	0.008 (0.05)	0.008 (0.05)	0.008 (0.05)
$D_{i,+6} * I_i$	-0.086 (0.09)	-0.108 (0.07)	-0.108 (0.07)	-0.108 (0.07)	-0.109 (0.07)
$D_{i,+7} * I_i$	0.033 (0.09)	-0.030 (0.07)	-0.029 (0.07)	-0.029 (0.07)	-0.029 (0.07)
$D_{i,+8} * I_i$	-0.127 (0.08)	-0.043 (0.06)	-0.043 (0.06)	-0.043 (0.06)	-0.043 (0.06)
$D_{i,+9} * I_i$	-0.122 (0.09)	-0.022 (0.08)	-0.023 (0.08)	-0.023 (0.08)	-0.023 (0.08)

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Table A2**Regression results: number of stocks traded around ex-dividend date (*continued*)**

	(1)	(2)	(3)	(4)	(5)
$D_{i,+10} * I_i$	0.053 (0.10)	0.023 (0.06)	0.023 (0.06)	0.023 (0.06)	0.023 (0.06)
Days before/after ex-dividend date – cum-ex period					
$D_{i,-10} * T_i$	-0.050 (0.06)	-0.072* (0.04)	-0.072* (0.04)	-0.072* (0.04)	-0.072* (0.04)
$D_{i,-9} * T_i$	-0.011** (0.05)	-0.090** (0.04)	-0.089** (0.04)	-0.089** (0.04)	-0.089** (0.04)
$D_{i,-8} * T_i$	0.035 (0.07)	0.018 (0.05)	0.018 (0.05)	0.018 (0.05)	0.018 (0.05)
$D_{i,-7} * T_i$	0.055 (0.06)	0.028 (0.05)	0.028 (0.05)	0.028 (0.05)	0.028 (0.05)
$D_{i,-6} * T_i$	0.032 (0.07)	0.068 (0.04)	0.067 (0.04)	0.067 (0.04)	0.067 (0.04)
$D_{i,-5} * T_i$	0.035 (0.06)	0.054 (0.05)	0.054 (0.05)	0.054 (0.05)	0.054 (0.05)
$D_{i,-4} * T_i$	-0.015 (0.06)	-0.002 (0.05)	-0.002 (0.05)	-0.002 (0.05)	-0.002 (0.05)
$D_{i,-3} * T_i$	0.030 (0.06)	0.036 (0.04)	0.036 (0.04)	0.036 (0.04)	0.036 (0.04)
$D_{i,-2} * T_i$	-0.287 (0.29)	-0.037 (0.15)	-0.038 (0.15)	-0.038 (0.15)	-0.038 (0.15)
$D_{i,-1} * T_i$	0.038 (0.13)	-0.001 (0.10)	-0.001 (0.10)	-0.001 (0.10)	-0.001 (0.10)
$D_{i,0} * T_i$	0.055 (0.06)	0.061 (0.04)	0.061 (0.04)	0.061 (0.04)	0.061 (0.04)
$D_{i,+1} * T_i$	0.093 (0.06)	0.099** (0.05)	0.099** (0.05)	0.099** (0.05)	0.099** (0.05)
$D_{i,+2} * T_i$	0.044 (0.06)	0.071 (0.05)	0.071 (0.05)	0.071 (0.05)	0.070 (0.05)
$D_{i,+3} * T_i$	0.080 (0.06)	0.084** (0.04)	0.084** (0.04)	0.084** (0.04)	0.084** (0.04)
$D_{i,+4} * T_i$	0.127* (0.06)	0.081 (0.05)	0.081 (0.05)	0.081 (0.05)	0.081 (0.05)
$D_{i,+5} * T_i$	0.034 (0.07)	0.074* (0.04)	0.074* (0.04)	0.074* (0.04)	0.074* (0.04)
$D_{i,+6} * T_i$	0.005 (0.06)	-0.011 (0.05)	-0.011 (0.05)	-0.011 (0.05)	-0.011 (0.05)
$D_{i,+7} * T_i$	0.076 (0.06)	0.093* (0.05)	0.093* (0.05)	0.093* (0.05)	0.093* (0.05)
$D_{i,+8} * T_i$	0.163*** (0.05)	0.100** (0.04)	0.100** (0.04)	0.100** (0.04)	0.100** (0.04)
$D_{i,+9} * T_i$	-0.013 (0.07)	0.052 (0.05)	0.052 (0.05)	0.052 (0.05)	0.051 (0.05)
$D_{i,+10} * T_i$	-0.011 (0.06)	0.012 (0.04)	0.012 (0.04)	0.012 (0.04)	0.012 (0.04)

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Table A2**Regression results: number of stocks traded around ex-dividend date (*continued*)**

	(1)	(2)	(3)	(4)	(5)
Constant	12.35*** (0.22)	11.93*** (0.00)	12.33*** (0.23)	12.00 (7.58)	12.00 (7.58)
Cum-ex period, T_i	-0.352 (0.40)		-0.724 (0.46)	-36.36*** (8.35)	-36.37*** (8.34)
Taxable dividend, I_i	-0.505** (0.24)		-0.539** (0.25)	-2.614 (7.69)	-2.614 (7.69)
$I_i * T_i$	0.435 (0.43)		0.710 (0.50)		
Estimation method	OLS	OLS(FE)	GLS(RE)	GLS(RE)	ML(ME)
Mundlak terms	-	-	-	yes	yes
Variances of random effects					
Random effect $D_{i,-2} * I_i * T_i$	-	-	-	-	0.102
Random effect $D_{i,-1} * I_i * T_i$	-	-	-	-	0.273
Random intercept	-	-	-	-	5.288

Note: The dependent variable is the natural logarithm of the traded number of stocks as reported in the XETRA data. The sample includes all German stocks that are constituents of the HDAX index between 2009 and 2015. It includes 103,386 observations for 806 dividend events by 155 firms. Due to missing values not all 829 dividend events in the data are included. $D_{i,d}$ takes a value of unity on day d before or after the ex-dividend date. I_i is a binary indicator that equals unity in the case of taxable dividends and zero in the case of withholding-tax-exempt dividends. T_i is a binary indicator that takes value unity for observations during the cum-ex period from January 2009 to December 2011, and zero in the post period, *i.e.* in the years 2012 to 2015. A 131-day window around each ex-dividend date is used for the regression analysis. Regression coefficients result from pooled OLS regressions (column (1)), as well as panel regressions with event-specific effects. This includes fixed effects (column (2)) and random effects (column (3) to (5)). Specification (5) allows for event-specific deviations from the average cum-ex effect on days -2 and -1 (random slopes). The variances of the random intercept and slope effects are reported at the bottom of the table. The employed estimation method, ordinary least squares, without (OLS) and with fixed effects (OLS(FE)), generalized least squares (GLS(RE)) with random effects, or mixed effects maximum likelihood (ML(ME)), and the use of Mundlak terms in random effects regressions is noted in the table. Cluster-robust standard errors (clustered at dividend-event level) are in parentheses. Asterisks denote statistical significance at the 0.01 (***), 0.05 (**) and 0.10 (*) levels.

Table A3
Robustness test: number of stocks traded and dividend yield

	(1)	(2)	(3)	(4)
Cum-ex period				
$D_{i,-2} * I_i * T_i$	0.482 (0.29)	0.256* (0.15)	0.257* (0.15)	0.257* (0.15)
$D_{i,-2} * I_i * T_i * DY_{adj,i}$	0.022 (0.08)	0.080*** (0.02)	0.080*** (0.02)	0.080*** (0.02)
$D_{i,-1} * I_i * T_i$	0.244 (0.15)	0.325*** (0.11)	0.325*** (0.11)	0.325*** (0.11)
$D_{i,-1} * I_i * T_i * DY_{adj,i}$	0.139 (0.09)	0.163*** (0.03)	0.163*** (0.03)	0.163*** (0.03)
Baseline effects				
$D_{i,-2} * I_i$	0.016 (0.08)	-0.021 (0.07)	-0.021 (0.07)	-0.021 (0.07)
$D_{i,-1} * I_i$	0.059 (0.07)	0.054 (0.07)	0.054 (0.07)	0.054 (0.07)
Estimation method	OLS	OLS(FE)	GLS(RE)	GLS(RE)
Mundlak terms	-	-	-	yes
P-value cum-ex effects	0.10	0.01	0.01	0.01
P-value other days	0.83	0.25	0.24	0.24

Note: The dependent variable is the natural logarithm of the traded number of stocks as reported in the XETRA data. The sample includes all German stocks that are constituents of the HDAX index between 2009 and 2015. It includes 103,386 observations for 806 dividend events by 155 firms. Due to missing values not all 829 dividend events in the data are included. $D_{i,d}$ takes a value of unity on day d before or after the ex-dividend date. I_i is a binary indicator that equals unity in the case of taxable dividends and zero in the case of withholding-tax-free dividends. T_i is a binary indicator that takes value unity for observations during the cum-ex period from January 2009 to December 2011, and zero in the post period, *i.e.* in the years 2012 to 2015. $DY_{adj,i}$ is the mean-adjusted dividend yield of event i . Note that the level of the mean-adjusted dividend yield is included as a control variable. Regression coefficients result from pooled OLS regressions (column (1)), fixed-effects (column (2)) and random-effects regressions (columns (3) and (4)). The employed estimation method, ordinary least squares, without (OLS) and with fixed effects (OLS(FE)), or generalized least squares (GLS(RE)) with random effects, and the use of Mundlak terms in random effects regressions is noted in the table. Cluster-robust standard errors (clustered at dividend-event level) are in parentheses. Asterisks denote statistical significance at the 0.01 (***) and 0.10 (*) levels.

Table A4**Robustness test: number of stocks traded and market capitalization**

	(1)	(2)	(3)	(4)
Cum-ex period				
$D_{i,-2} * I_i * T_i$	0.517* (0.29)	0.272* (0.15)	0.274* (0.15)	0.274* (0.15)
$D_{i,-2} * I_i * T_i * Cap_{adj,i}$	0.346*** (0.08)	0.160*** (0.02)	0.160*** (0.02)	0.160*** (0.02)
$D_{i,-1} * I_i * T_i$	0.286* (0.15)	0.344*** (0.11)	0.344*** (0.11)	0.344*** (0.11)
$D_{i,-1} * I_i * T_i * Cap_{adj,i}$	0.397*** (0.09)	0.204*** (0.02)	0.205*** (0.02)	0.205*** (0.02)
Baseline effects				
$D_{i,-2} * I_i$	0.011 (0.08)	-0.021 (0.07)	-0.021 (0.07)	-0.021 (0.07)
$D_{i,-1} * I_i$	0.057 (0.07)	0.054 (0.07)	0.054 (0.07)	0.054 (0.07)
Estimation method	OLS	OLS(FE)	GLS(RE)	GLS(RE)
Mundlak terms	-	-	-	yes
P-value cum-ex effects	0.10	0.00	0.00	0.00
P-value other days	0.83	0.24	0.24	0.24

Note: The dependent variable is the natural logarithm of the traded number of stocks as reported in the XETRA data. The sample includes all German stocks that are constituents of the HDAX index between 2009 and 2015. It includes 103,386 observations for 806 dividend events by 155 firms. Due to missing values not all 829 dividend events in the data are included. $D_{i,d}$ takes a value of unity on day d before or after the ex-dividend date. I_i is a binary indicator that equals unity in the case of taxable dividends and zero in the case of withholding-tax-free dividends. T_i is a binary indicator that takes value unity for observations during the cum-ex period from January 2009 to December 2011, and zero in the post period, *i.e.* in the years 2012 to 2015. $Cap_{adj,i}$ is the mean-adjusted market capitalization of event i . Note that the level of the mean-adjusted market capitalization is included as a control variable. Regression coefficients result from pooled OLS regressions (column (1)), fixed-effects (column (2)) and random-effects regressions (columns (3) and (4)). The employed estimation method, ordinary least squares without (OLS) and with fixed-effects (OLS(FE)) or generalized least squares (GLS(RE)) with random effects, and the use of Mundlak terms in random effects regressions is noted in the table. Cluster-robust standard errors (clustered at dividend-event level) are in parentheses. Asterisks denote statistical significance at the 0.01 (***) and 0.10 (*) levels.