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Article

Private Equity Transactions: Value Creation through Operational Engineering – Evidence from Europe

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Online-Appendix zu

„Private Equity Transactions: Value Creation through Operational Engineering – Evidence from Europe”

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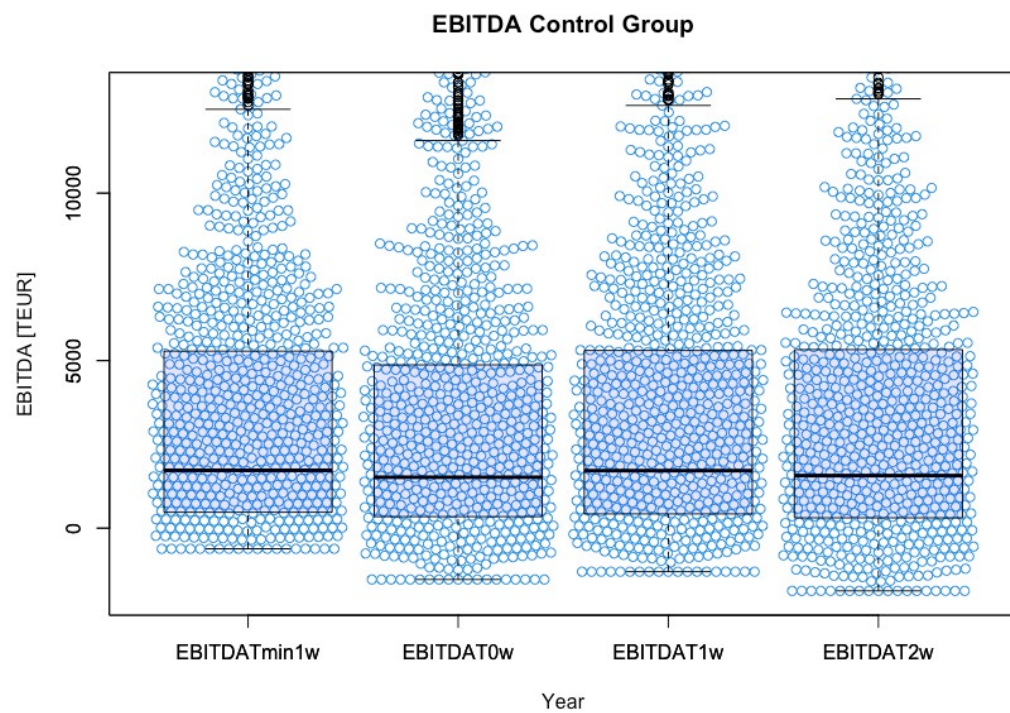
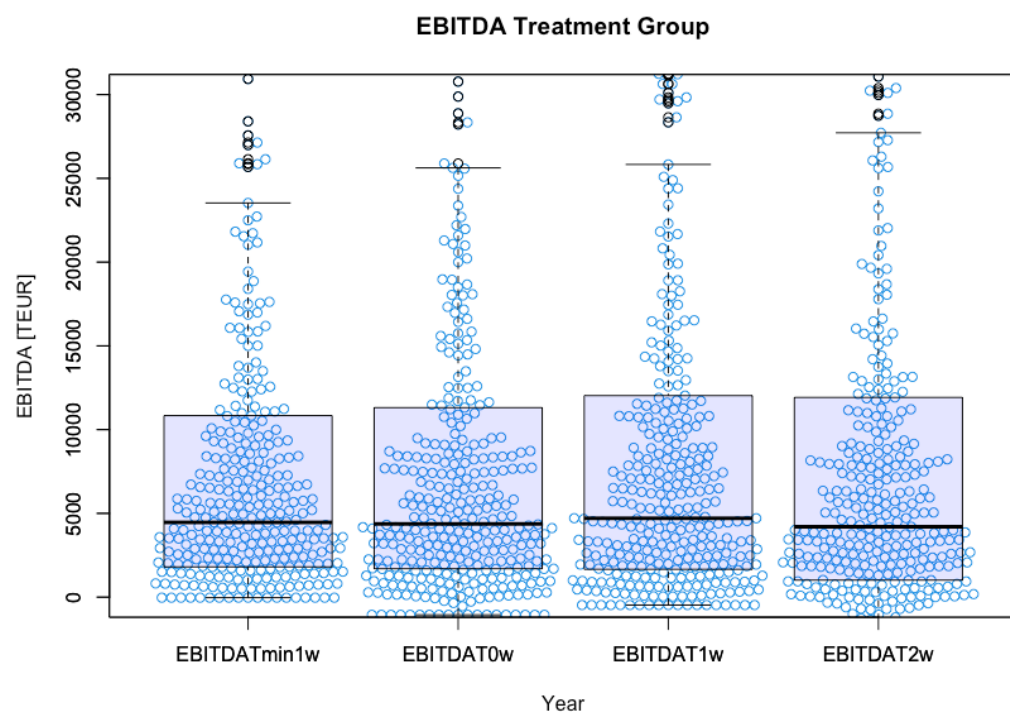
Junior Management Science 8(3) (2023) 634-657

Appendix

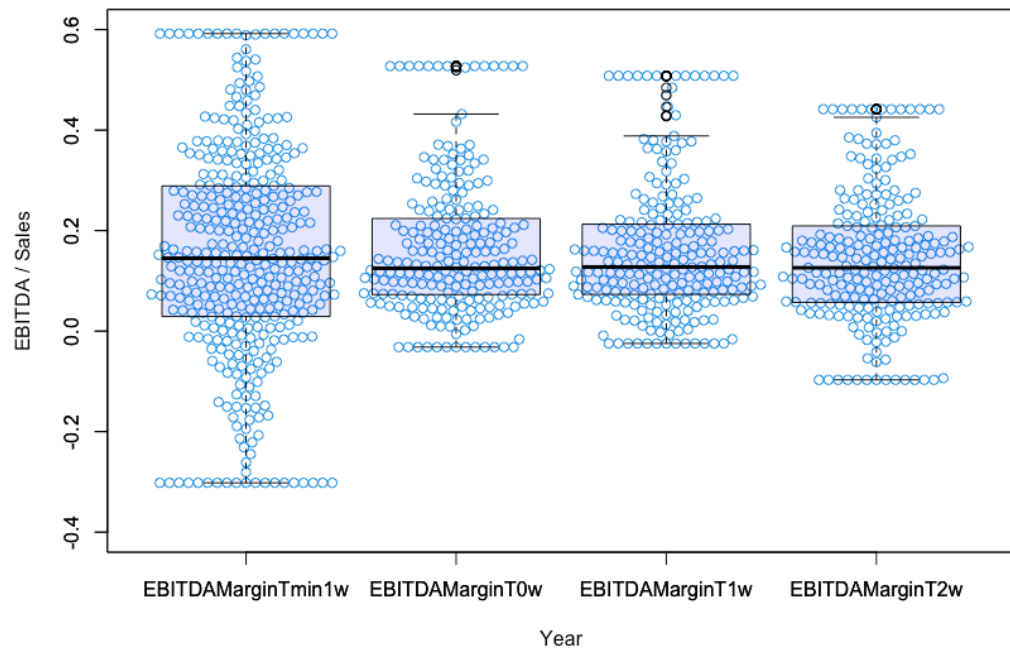
Appendix 1: Variable Definition

CapEx	$\Delta \text{fixed Assets} + \text{Depreciation}$
EBITDA	$\text{Operating Profit} + \text{Depreciation} + \text{Audit Fee}$
EBITDA Margin	$\frac{\text{EBITDA}}{\text{Sales}}$
Free Cash Flow	$\text{EBITDA} + \Delta \text{Net Working Capital} - \text{CapEx}$
FCF Margin	$\frac{\text{FCF}}{\text{Sales}}$
$\Delta \text{fixed Assets}$	$\text{fixed Assets}_{t1} - \text{fixed Assets}_{t0}$
Gearing Ratio	$\frac{\text{short term loans} + \text{long term liabilities}}{\text{Shareholder's Equity}}$
Net Working Capital	$\text{Current Assets} - \text{Current Liabilities}$
$\Delta \text{Net Working Capital}$	$\text{Net Working Capital}_{t1} - \text{Net Working Capital}_{t0}$
Shareholder's Equity	$\text{Issued Capital} + \text{Total Reserves}$

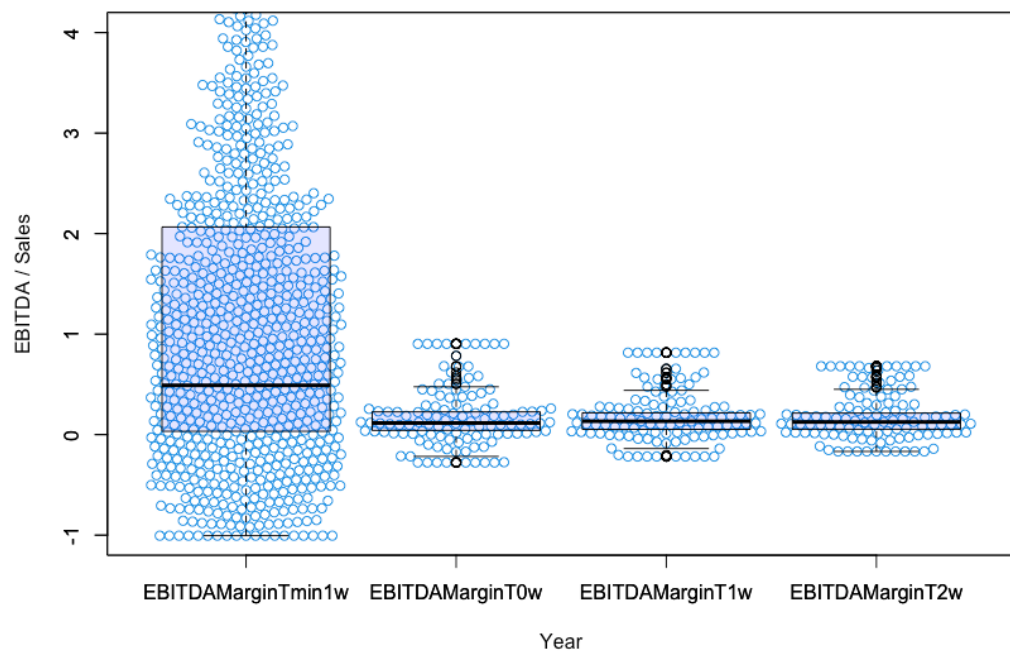
Appendix 2: Graphical Representation of KPI differences between Treatment and Control Group at Buyout

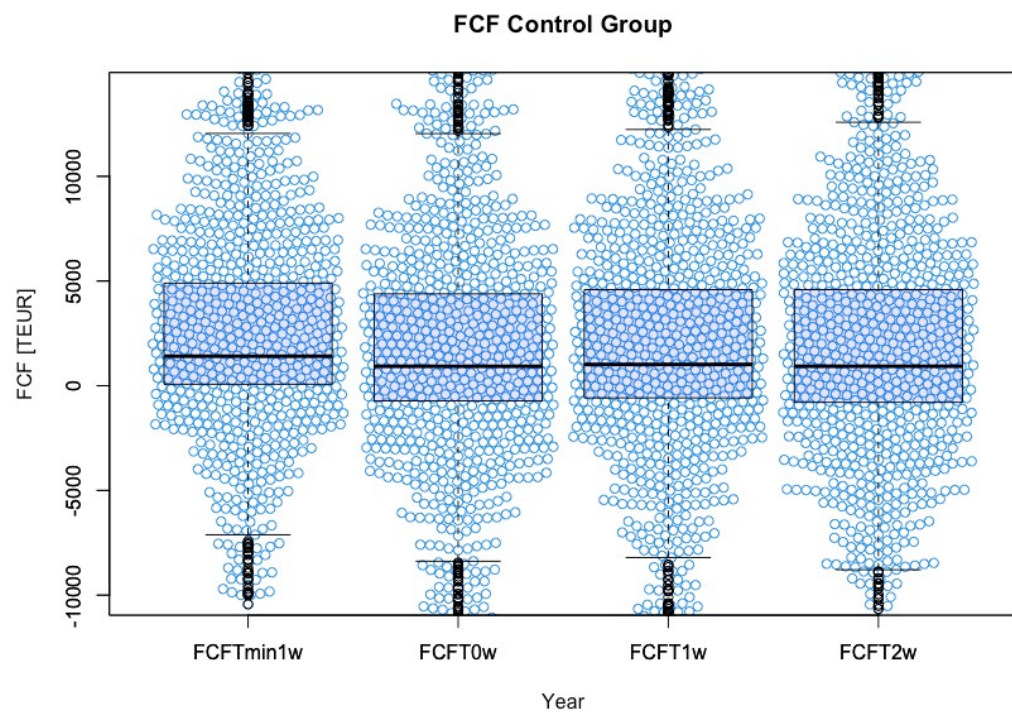
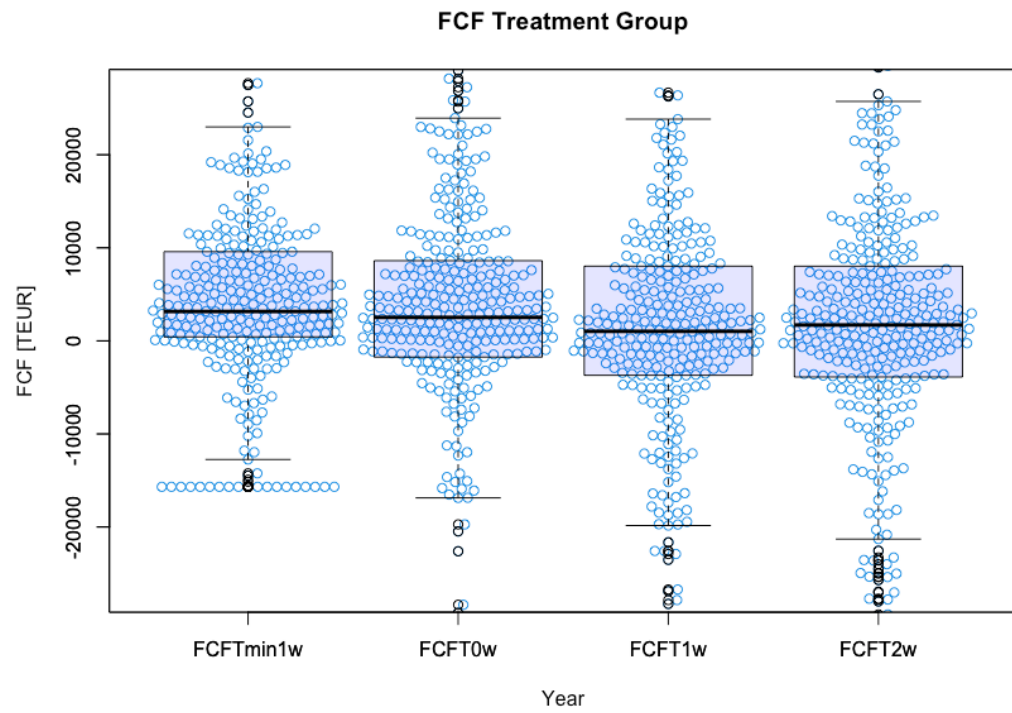


EBITDA Margin Treatment Group

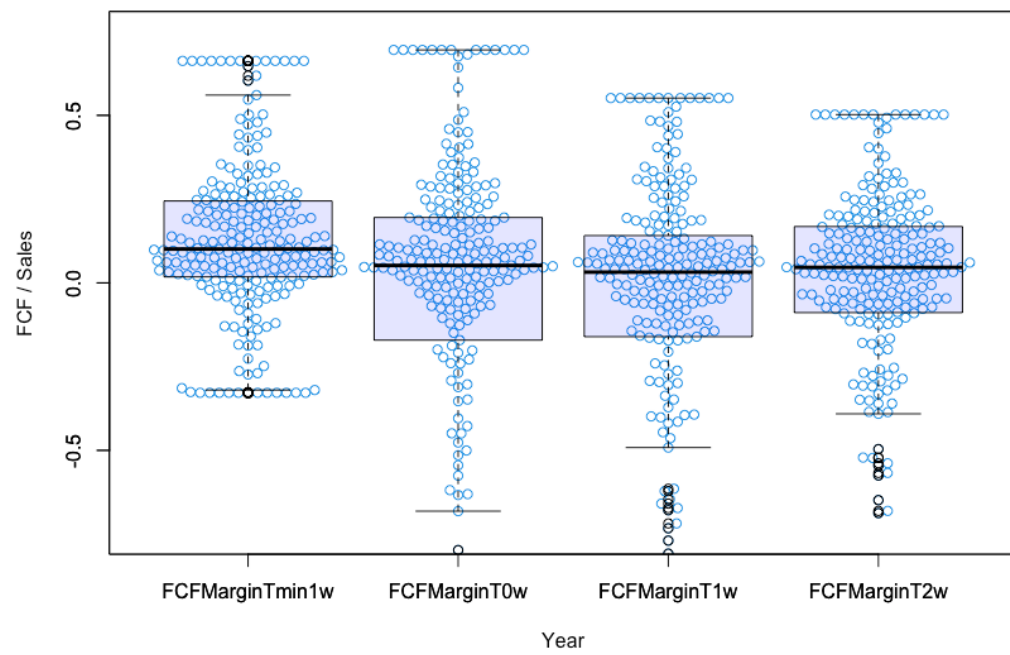


EBITDA Margin Control Group

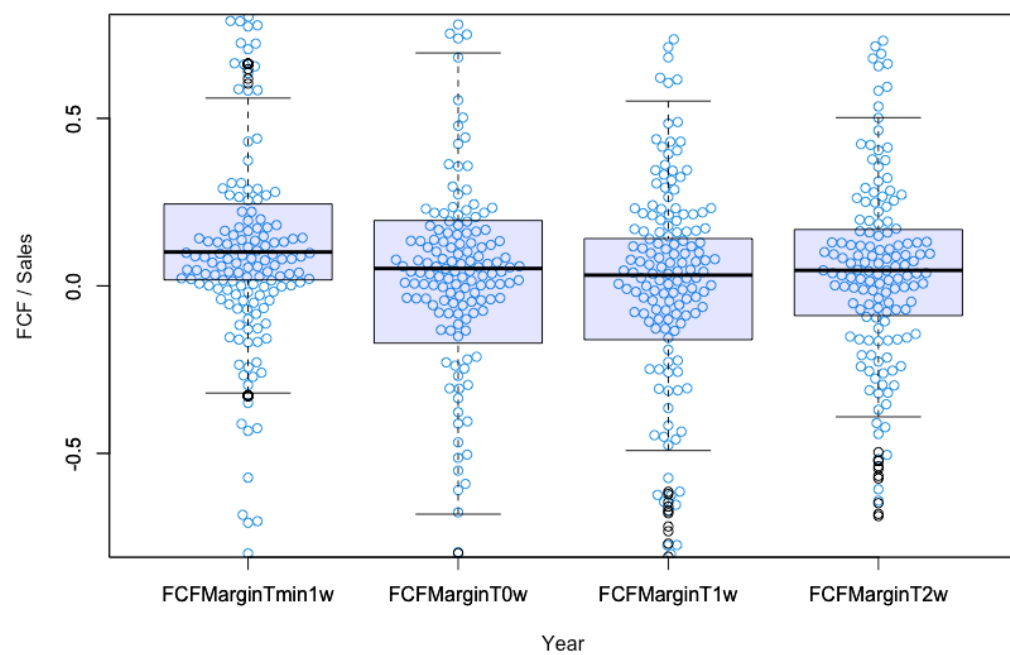


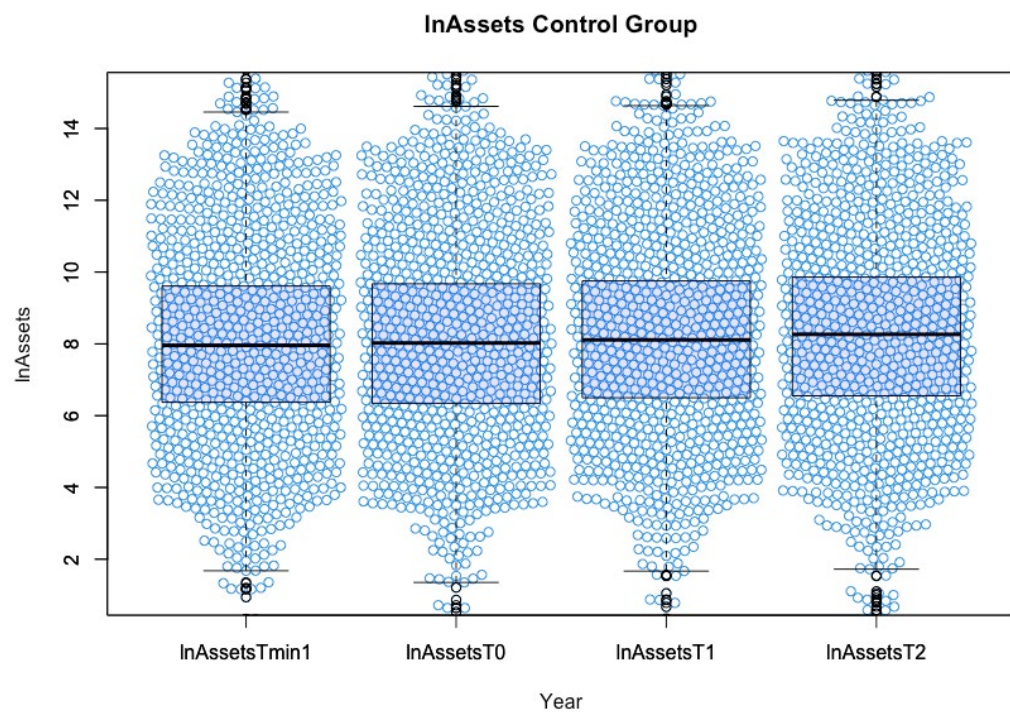
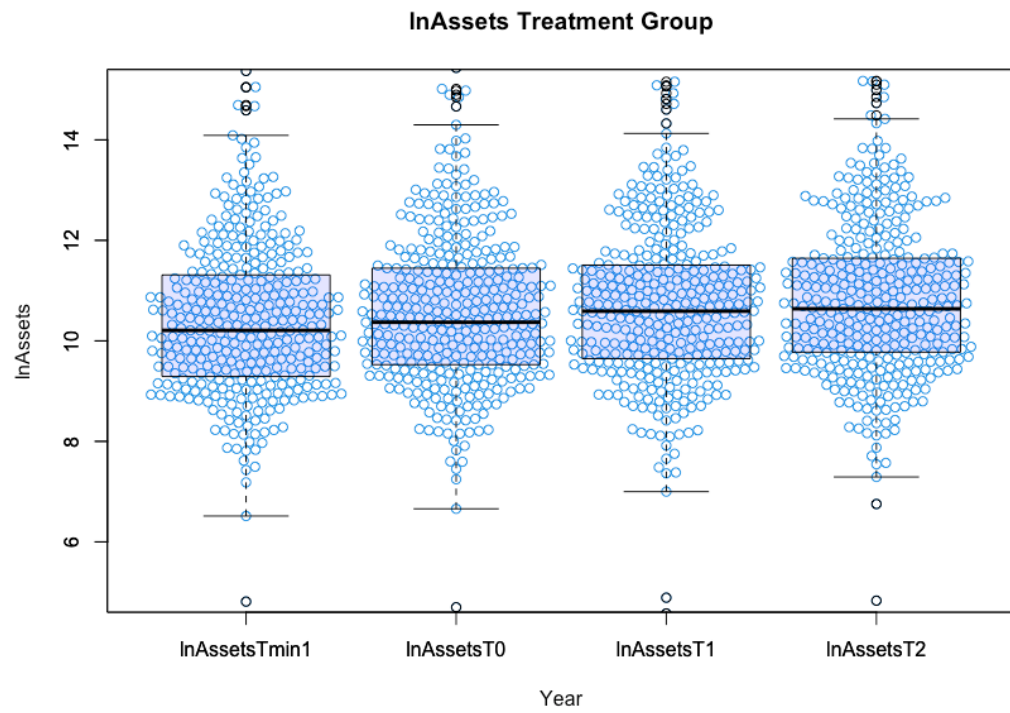


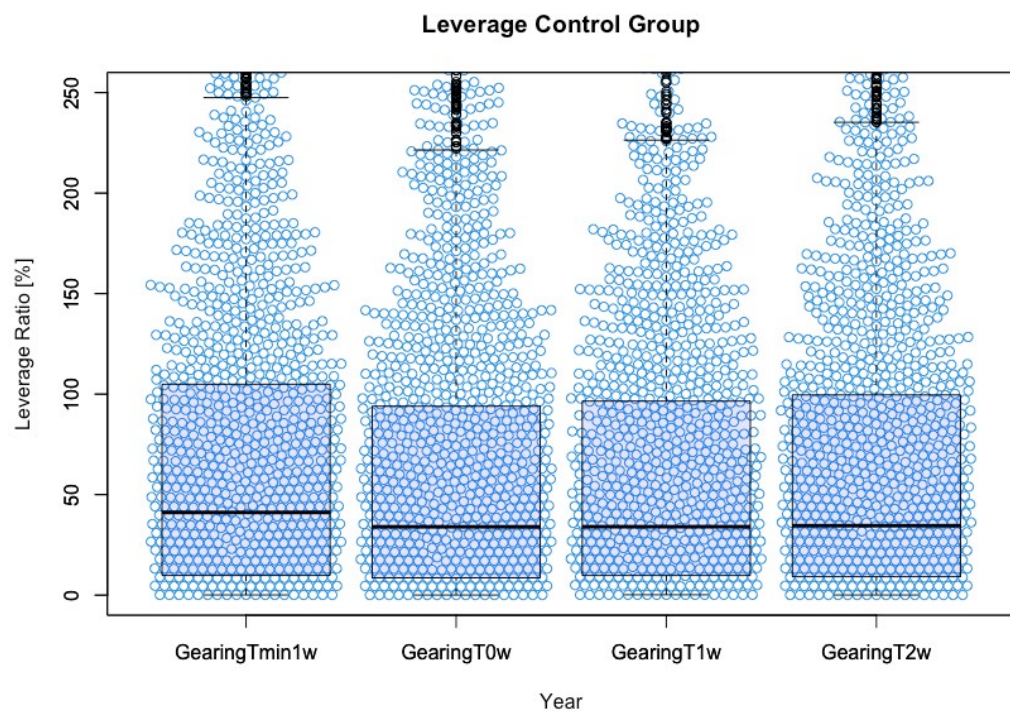
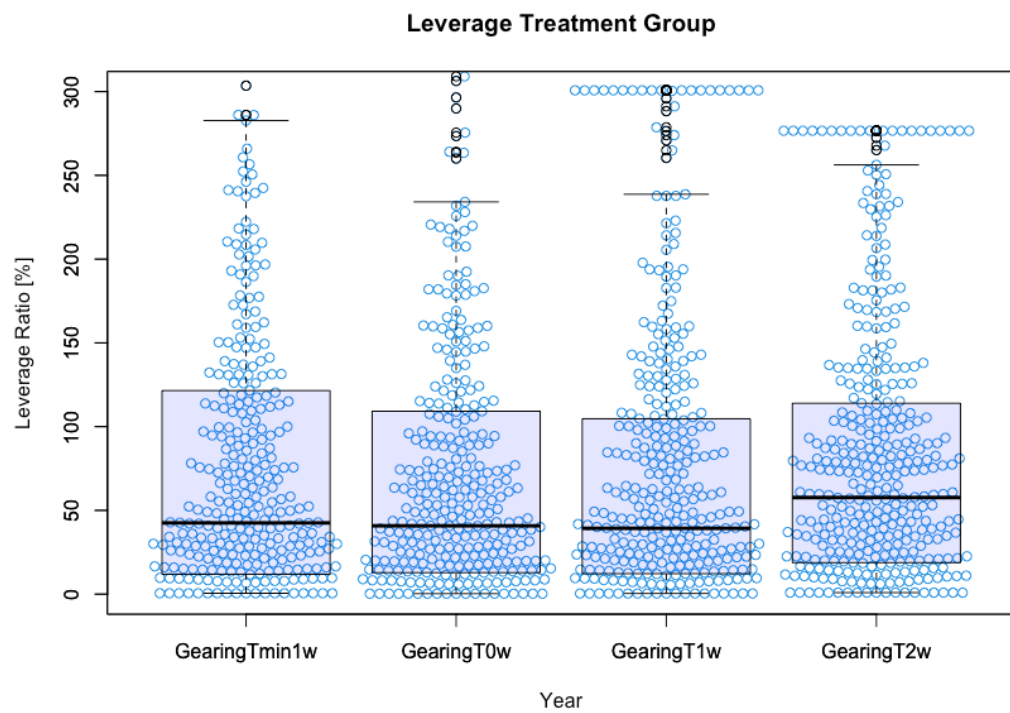
FCF Margin Treatment Group



FCF Margin Control Group







Appendix 3: Descriptive Statistics of Treatment and Control Group before, during, and after buyout

TABLE A-1

Representing the KPIs of interest (with **(A)** EBITDA in TEUR, **(B)** EBIDTA margin in %, **(C)** FCF in TEUR, **(D)** FCF margin in %, **(E)** sales in TEUR, **(F)** lnAssets, and **(G)** leverage in %) for both Treatment and Control Group for the observation period T-1 until T+2 for comparison and get and overview of the datasets retrieved from Orbis. In addition, t tests on means and Wilcoxon Signed Rank test on medians for differences between both groups. Significant difference between groups is denoted with an asterix (*).

		Treatment Group				Control Group			
		T-1	T0	T+1	T+2	T-1	T0	T+1	T+2
A	Mean	10,455.35*	10,039.81*	11,146.99*	10,715.49*	6,370.89*	6,249.13*	7,063.82*	6,680.91*
	Median	4,428.27*	4,291.80*	4,660.52*	4,051.80*	1,614.38*	1,417.40*	1,594.68*	1,468.07*
	SDev	15,093.96	14,193.02	15,892.03	16,335.17	12,762.59	13,060.57	15,002.00	13,935.71
	Min	-33.34	-1,055.89	-472.61	-2,994.96	-617.68	-1,533.62	-1,301.20	-1,873.18
	Max	58,292.40	54,124.35	60,504.96	60,718.07	53,279.49	54,293.47	63,133.33	57,978.47
B	Mean	15.44%*	16.38%	16.11%	14.38%	24.75%*	16.63%	17.62%	16.68%
	Median	14.57%*	12.51%	12.76%	12.60%	49.37%*	11.59%	13.29%	12.57%
	SDev	21.80%	13.64%	13.43%	13.12%	49.35%	26.66%	23.29%	20.83%
	Min	-30.18%	-3.18%	-2.46%	-9.70%	-100.57%	-27.76%	-21.77%	-16.39%
	Max	59.20%	52.75%	60.50%	60.72%	189.31%	90.32%	81.55%	68.05%
C	Mean	7,282.83*	-191.75*	1,373.56	1,439.07	4,985.03*	2,522.40*	2,668.15	3,030.41
	Median	3,129.98*	2,477.78*	998.54	1,552.34	1,304.26*	848.09*	974.63	875.45
	SDev	15,679.67	24,248.43	19,650.44	17,037.18	13,560.04	13,788.34	13,439.68	13,431.45
	Min	-15,684.82	-70,585.17	-43,312.09	-38,943.03	-13,416.74	-29,917.13	-28,620.04	-22,649.27
	Max	56,221.79	43,324.02	47,574.30	44,147.72	53,402.29	41,645.90	41,891.51	45,082.85
D	Mean	12.78%	-11.11%	-11.90%	0.00%*	-0.84%	-22.84%	-12.01%	14.81%*
	Median	10.10%	5.19%	3.21%	4.62%	6.75%	3.55%	2.98%	4.78%
	SDev	23.18%	61.05%	55.92%	30.64%	97.89%	107.09%	82.07%	93.35%
	Min	-32.82%	-191.15%	-193.78%	-83.57%	-298.76%	-377.37%	-261.88%	-176.25%
	Max	66.26%	69.53%	55.17%	50.23%	188.63%	108.70%	140.18%	279.77%
E	Mean	63,668.38*	66,716.39*	72,726.14*	77,451.70*	653,022.60*	734,552.90*	713,526.95*	716,360.10*
	Median	30,729.79*	30,491.58*	35,442.04*	37,038.34*	92,170.00*	93,601.00*	101,229.30*	98,746.00*
	SDev	85,145.19	92,518.30	98,248.62	106,023.90	1,417,055.00	1,578,865.00	1,505,218.00	1,510,000.00
	Min	2,907.96	2,703.25	2,376.20	3,926.79	6,764.25	4,518.12	6,344.50	6,978.72

	Max	344,118.10	381,238.10	382,932.50	423,991.30	6,018,063.00	6,305,791.00	6,028,817.00	6,186,093.00
		Treatment Group				Control Group			
		T-1	T0	T+1	T+2	T-1	T0	T+1	T+2
F	Mean	10.40*	10.56*	10.68*	10.79*	8.05*	8.05*	8.15*	8.21*
	Median	10.19*	10.34*	10.57*	10.60*	7.91*	7.96*	8.06*	8.21*
	SDev	1.51	1.51	1.55	1.53	2.57	2.60	2.60	2.65
	Min	4.81	4.70	4.58	4.83	-3.49	-2.43	-0.17	-1.04
	Max	15.67	15.81	15.95	16.24	19.21	19.28	19.35	19.38
G	Mean	88.16%	79.44%*	72.84%	80.55%	77.54%	68.48%*	69.44%	72.31%
	Median	41.42%	40.86%*	38.80%	57.46%*	41.21%	33.87%*	33.60%	33.14%*
	SDev	108.08%	96.08%	83.89%	77.98%	93.66%	84.25%	86.19%	91.23%
	Min	0.52%	0.27%	0.38%	0.89%	0.10%	0.05%	0.17%	0.08%
	Max	397.89%	357.63%	300.77%	276.65%	340.25%	306.08%	312.01%	333.60%

Appendix 4: Fama-French five industries classification based on SIC codes

FF1 Consumer Durables, Nondurables, Wholesale, Retail, some Services (Laundries, Repair Shops)

SIC 0100-0999	SIC 2000-2399	SIC 2700-2749
SIC 2770-2799	SIC 3100-3199	SIC 3940-3989
SIC 2500-2519	SIC 2590-2599	SIC 3630-3659
SIC 3710-3711	SIC 3714-3714	SIC 3716-3716
SIC 3750-3751	SIC 3792-3792	SIC 3900-3939
SIC 3990-3999	SIC 5000-5999	SIC 7200-7299
SIC 7600-7699		

FF2 Manufacturing, Energy, and Utilities

SIC 2520-2589	SIC 2600-2699	SIC 2750-2769
SIC 2800-2829	SIC 2840-2899	SIC 3000-3099
SIC 3200-3569	SIC 3580-3629	SIC 3700-3709
SIC 3712-3713	SIC 3715-3715	SIC 3717-3749
SIC 3752-3791	SIC 3793-3799	SIC 3830-3839
SIC 3860-3899	SIC 1200-1399	SIC 2900-2999
SIC 4900-4949		

FF3 High-tech, Business Equipment, Telephone and Television Transmission

SIC 3570-3579	SIC 3622-3622	SIC 3660-3692
SIC 3694-3699	SIC 3810-3839	SIC 7370-7372
SIC 7373-7373	SIC 7374-7374	SIC 7375-7375
SIC 7376-7376	SIC 7377-7377	SIC 7378-7378
SIC 7379-7379	SIC 7391-7391	SIC 8730-8734
SIC 4800-4899		

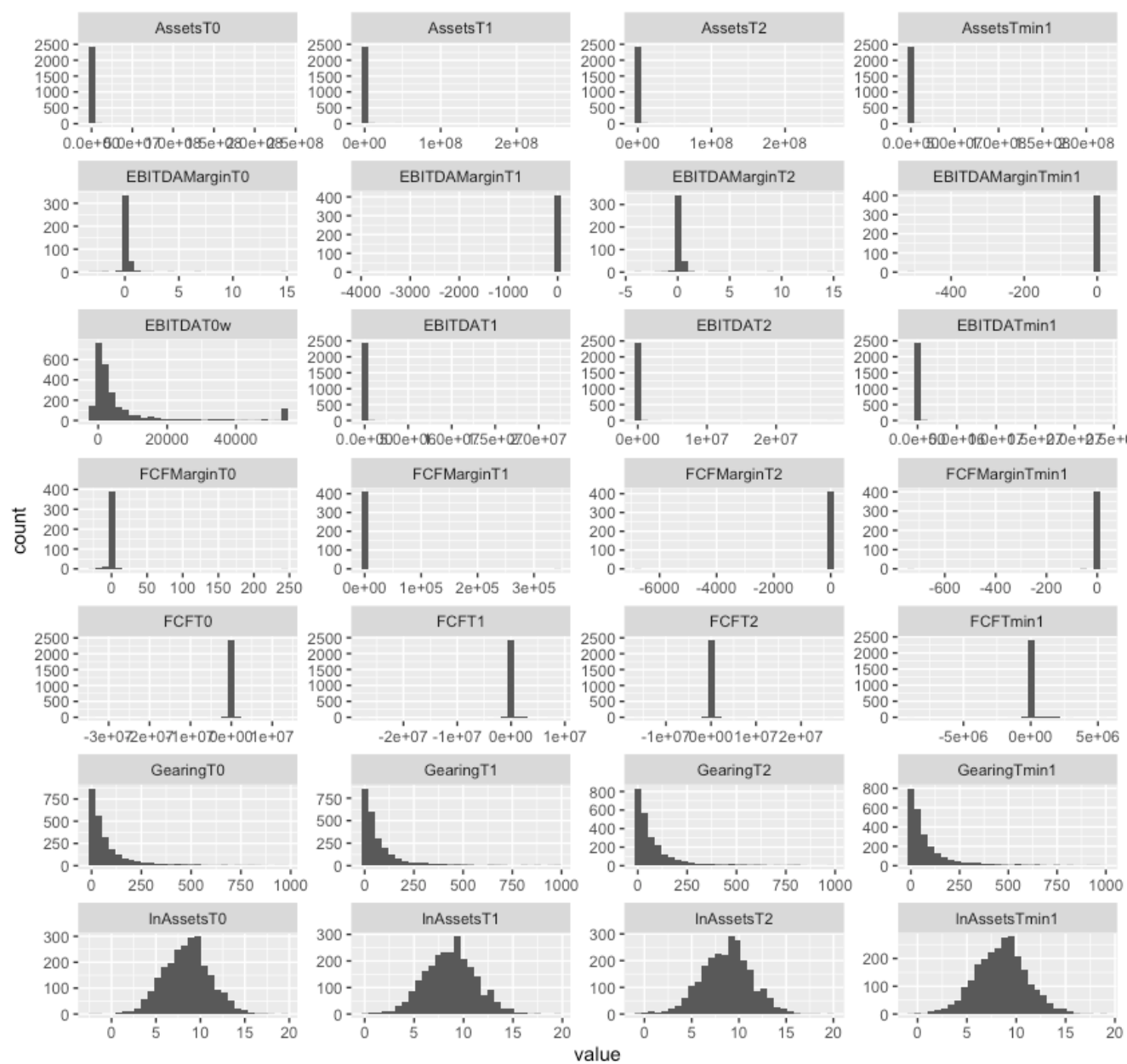
FF4 Healthcare, Medical Equipment, and Drugs

SIC 2830-2839	SIC 3693-3693	SIC 3840-3859
SIC 8000-8099		

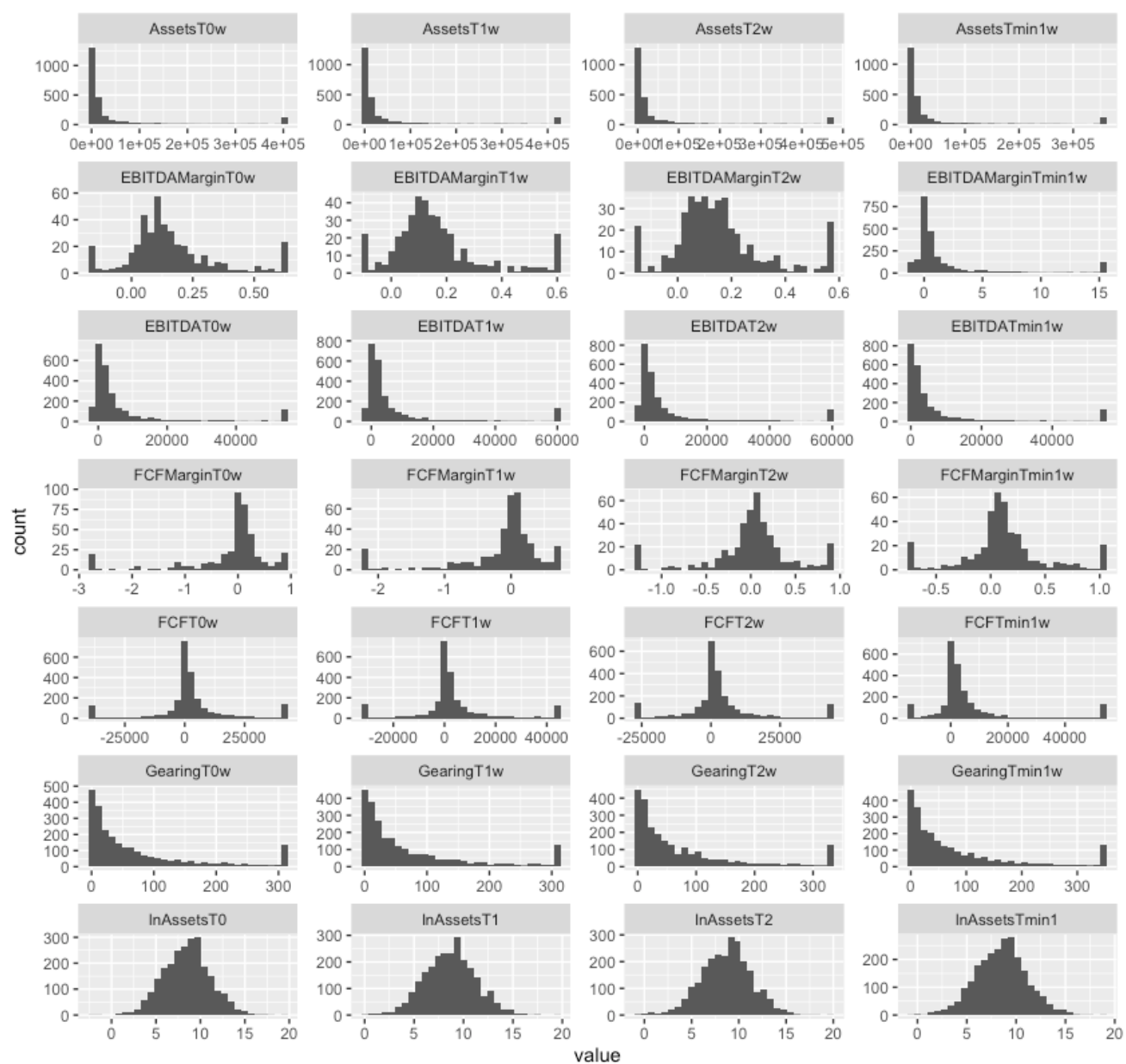
FF5 Other (Mines, Construction, Building Management, Transportation, Hotels, Business Services, Entertainment, Finance)

Appendix 5: Data Distribution - Effect of Winsorization

Unwinsorized data



Winsorized data



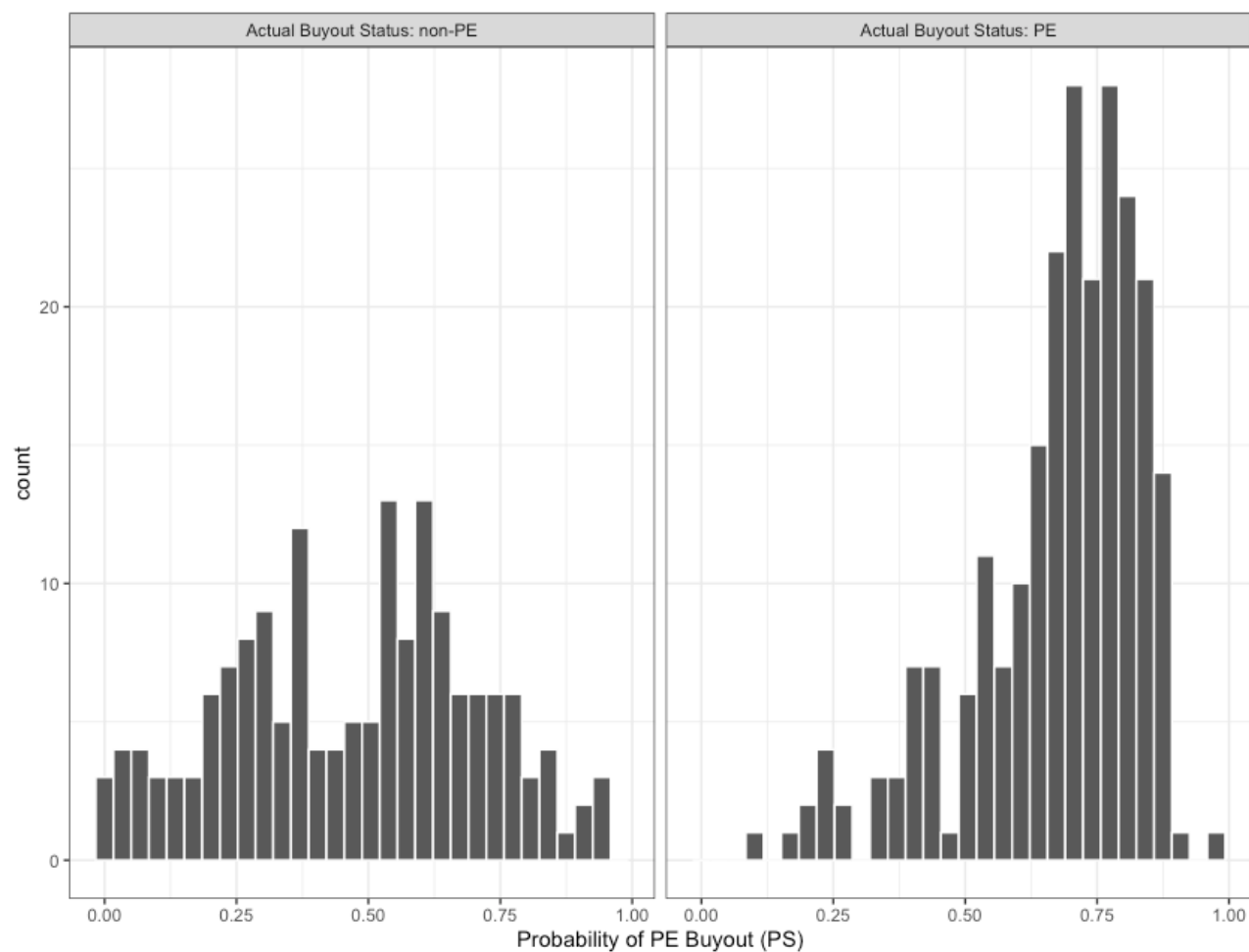
Appendix 6: Tests on absolute size quartile development between treatment and control group pre- and post-buyout

TABLE A-2

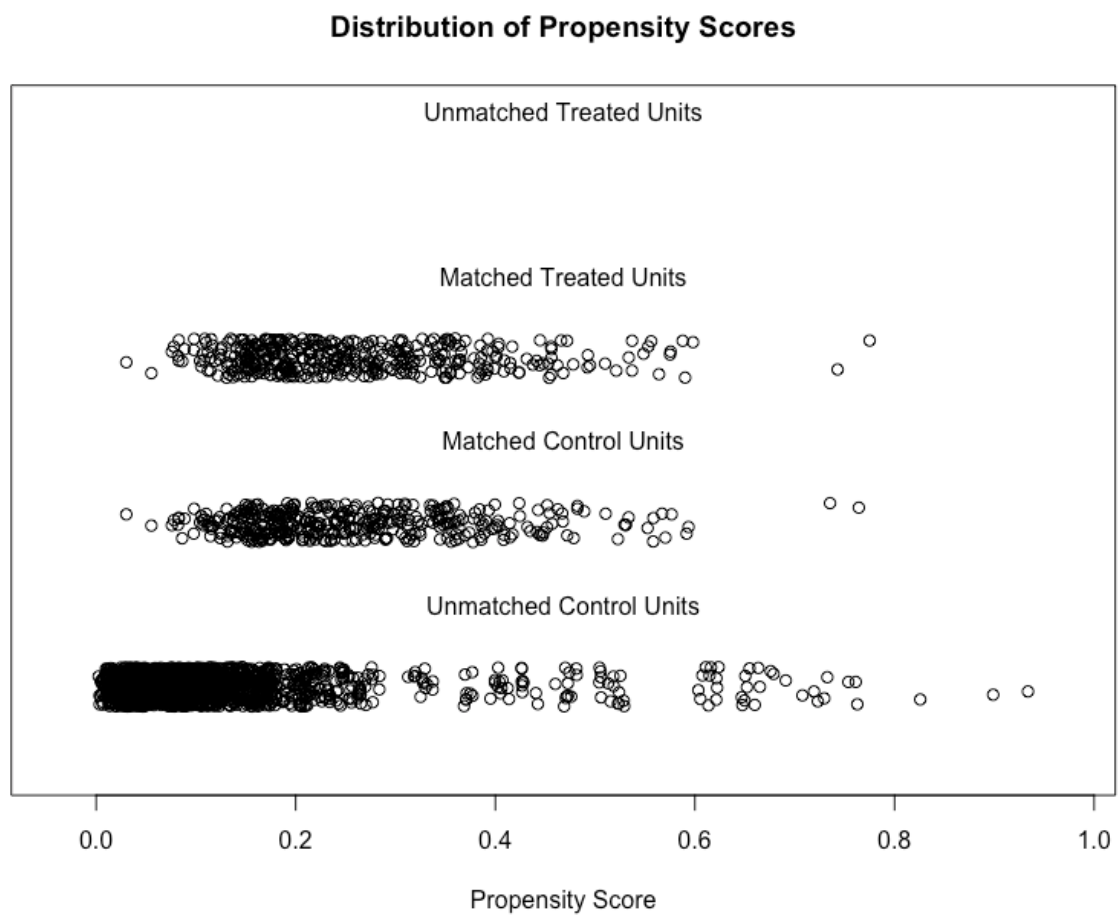
Quartile Comparison: Control Group in parentheses, T+2 in *italics*. Figures stated in TEUR unless denoted otherwise (except for lnAssets). Statistically significant difference in means, as tested by t test on a 5% significance level, is denoted by an asterisk (*).

KPI	T Tests on KPI Quartiles			
	Q1	Q2	Q3	Q4
EBITDA	705.54 (-29.00) *	3,015.44 (1,034.54) *	7,190.01 (3,031.53) *	31,562.54 (22,580.03) *
	364.77 (-128.67) *	2,507.78 (865.64) *	7,250.06 (2,928.00) *	33,328.02 (22,749.05) *
EBITDA Margin	-11.57% (-42.58%) *	8.82% (22.61%) *	21.04% (107.01%) *	43.67% (889.85%) *
	-8.98% (-39.35%) *	8.94% (9.25%)	16.15% (16.65%)	37.14% (406.20%) *
FCF	-6,010.35 (-4,518.57) *	1,743.85 (650.86) *	5,834.24 (2,856.50) *	28,061.79 (21,973.50) *
	-12,157.68 (-7,050.19) *	83.68 (229.24)	4,269.15 (2,381.09) *	25,560.38 (21,025.66) *
FCF Margin	-12.78% (-64.98%) *	8.30% (15.10%) *	21.78% (114.13%) *	49.37% (93.18%) *
	-24.76% (-149.37%) *	0.00% (4.40%) *	10.18% (58.62%) *	36.01% (187.82%) *
Sales	6,542.61 (13,868.29) *	18,827.90 (54,594.44) *	49,065.87 (196,074.00) *	180,237.10 (236,418.00) **
	7,978.80 (13,184.95) *	24,270.85 (54,328.54) *	57,114.31 (208,264.40) *	198,205.40 (245,473.00)
lnAssets	8.71 (4.93) *	9.76 (7.21) *	10.75 (8.80) *	12.46 (11.40) *
	8.99 (5.09) *	10.18 (7.42) *	11.05 (9.02) *	12.66 (11.62) *
Leverage	3.78% (3.25%)	26.66% (23.69%) *	77.75% (67.50%) *	247.34% (216.20%) *
	6.54% (3.07%) *	36.17% (20.57%) *	84.59% (60.89%) *	237.90% (209.98%) *

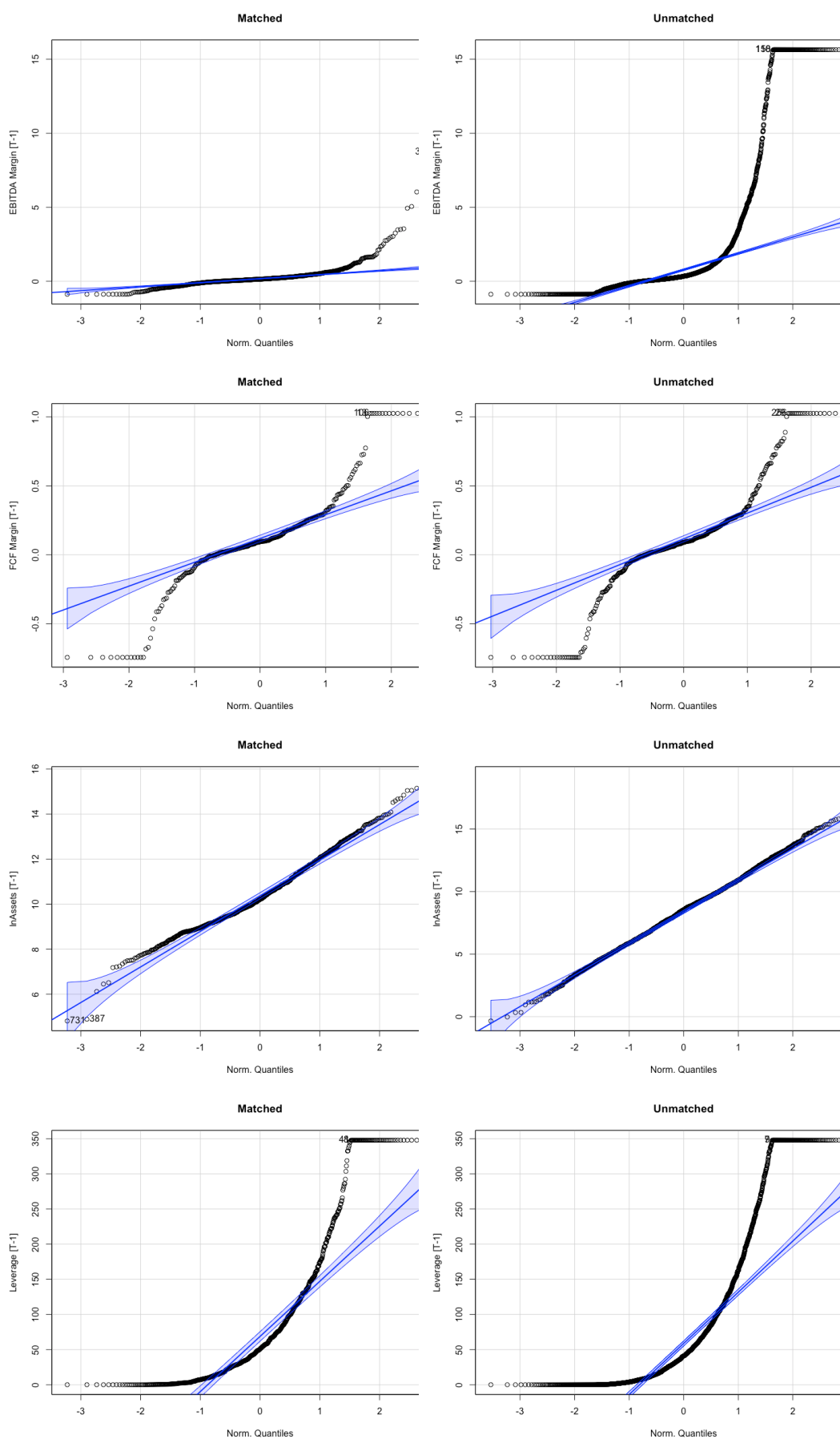
Appendix 7: Propensity Score Matching Area of Common Support of Treatment and Control Group



Appendix 8: Visual Assessment of PSM Quality with Group Distribution Balance



Appendix 9: PSM Covariate Balance Inspection



Appendix 10: Regression Model Equations

Logistic regression models used for propensity score matching - PS estimation

$$PS = \beta_0 + \beta_2 * (EBITDA\ Margin_{T-1}) + \beta_2 * (FCF\ Margin_{T-1}) \\ + \beta_3 * (lnAssets_{T-1}) + \beta_4 * (Leverage_{T-1}) \\ (A1)$$

In this model, I have simultaneously controlled for year-, country-, industry-, and firm-fixed effects

Logistic regression models used in *Table 4*:

Models (A2) and (A3) estimate the probability P of a PE buyout given, i.e., under the stochastic condition, of a set of certain KPI levels to be considered in each model. In all cases it holds true that $P(PE\ Buyout | x) \in \{0, 1\} \forall i \wedge t \in \{2013, 2019\}$.

Model (A2) displayed as model I:

$$P(PE\ Buyout | EBITDA\ Margin\ Quartile_{T-1}, FCF\ Margin\ Quartile_{T-1}) \\ = 1 - (1 + \exp(\beta_1 * EBITDA\ Margin\ Quartile_{T-1} + \beta_2 * \\ FCF\ Margin\ Quartile_{T-1} + \varepsilon))^{-1} \quad (A2)$$

Model (A3) displayed as model II, only including β_1 , β_2 , and β_3 , and model II including all coefficients:

$$P(PE\ Buyout | EBITDA\ Margin_{T-1}, EBITDA\ Margin\ Quartile_{T-1}, EBITDA\ Quartile_{T-1}, \\ lnAssets\ Quartile_{T-1}, Leverage\ Quartile_{T-1}, Sales\ Quartile_{T-1}) \\ = 1 - (1 + \exp(\beta_1 * EBITDA\ Margin_{T-1} + \beta_2 \\ * EBITDA\ Margin\ Quartile_{T-1} + \\ \beta_3 * EBITDA\ Quartile_{T-1} + \beta_4 * lnAssets\ Quartile_{T-1} \\ + \beta_5 * Leverage\ Quartile_{T-1} + \\ \beta_6 * Sales\ Quartile_{T-1} + \varepsilon))^{-1} \\ (A3)$$

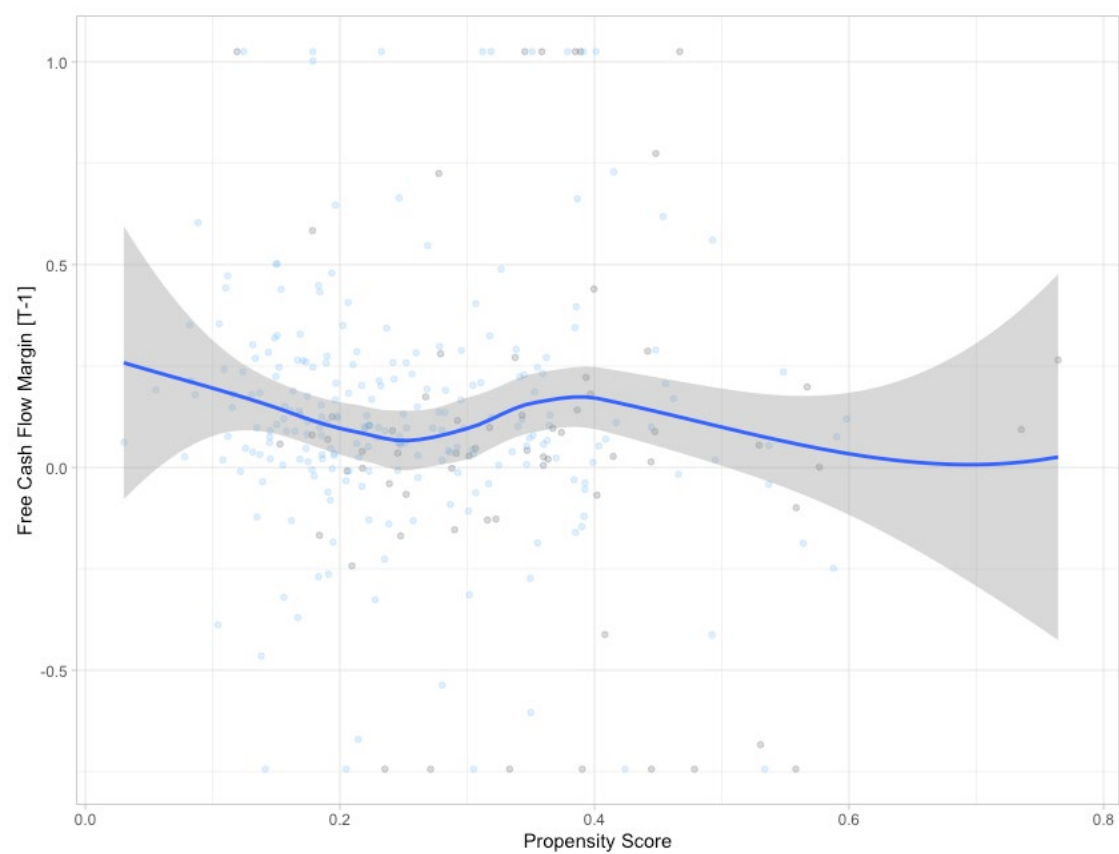
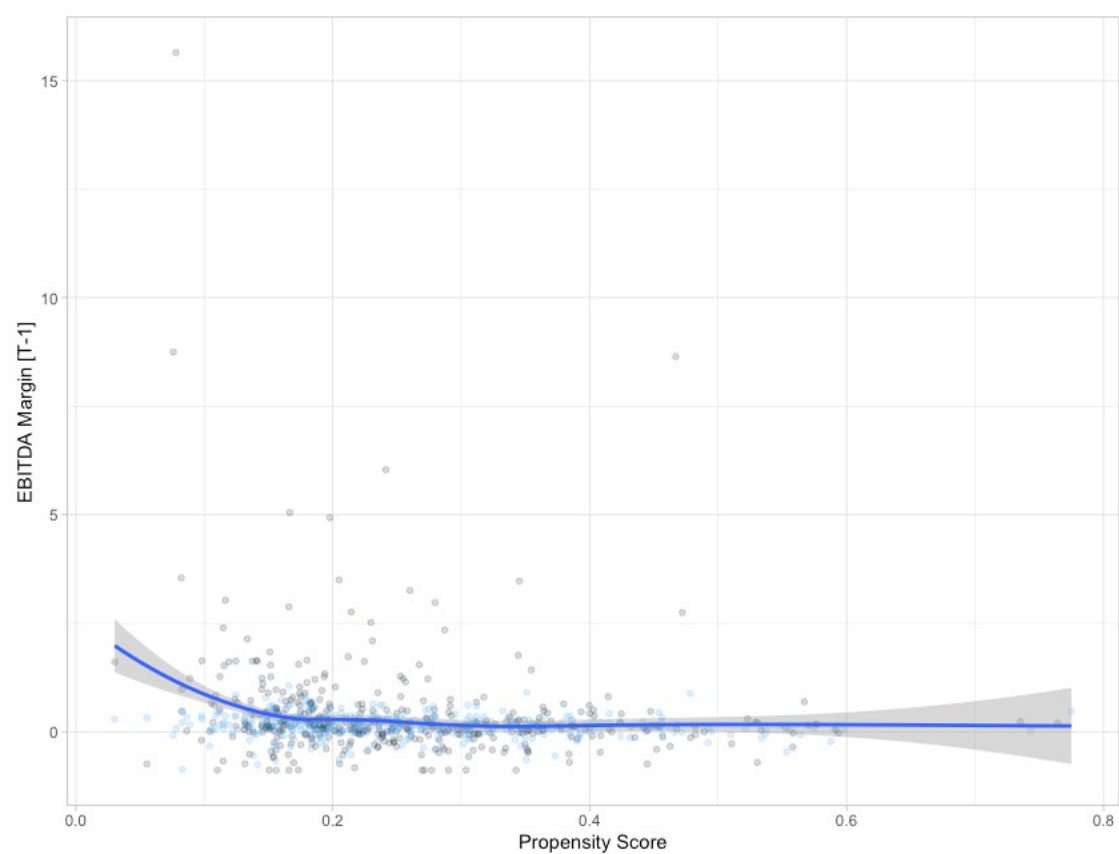
Model (A4) displayed as model IV, only including β_1 , β_2 , and β_3 , and model V including all coefficients.

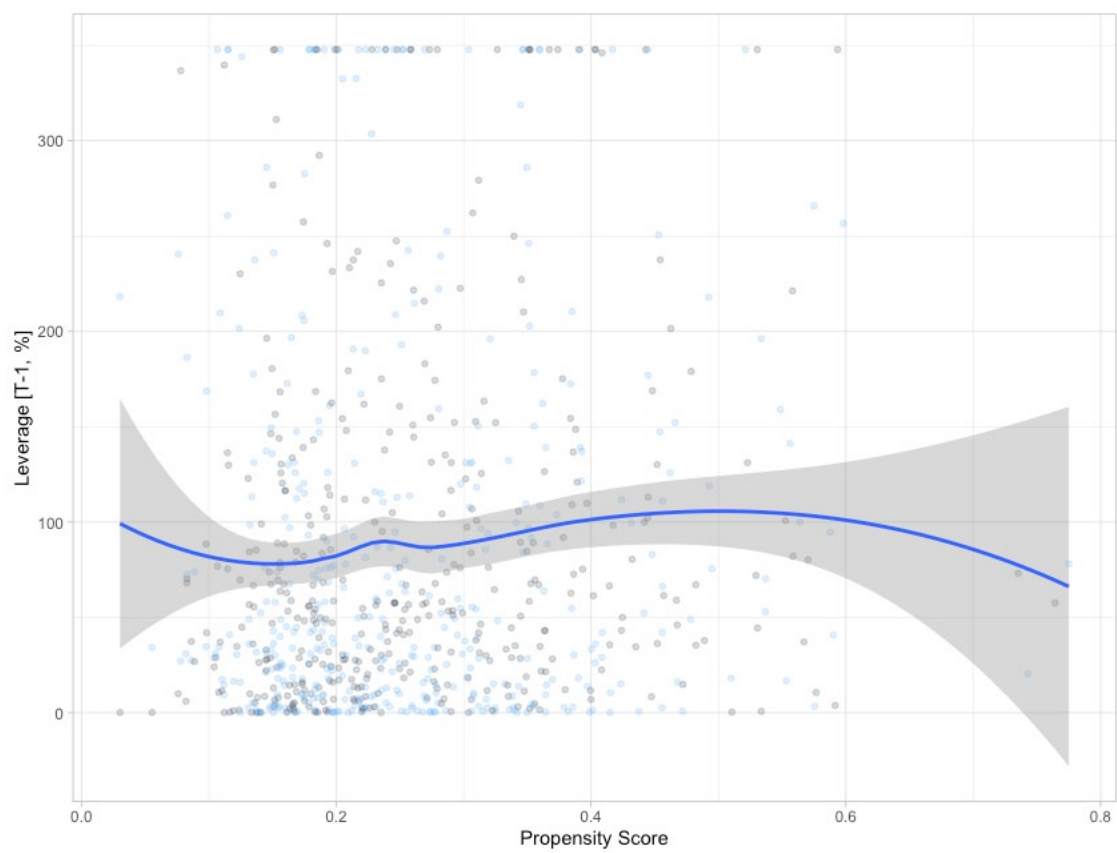
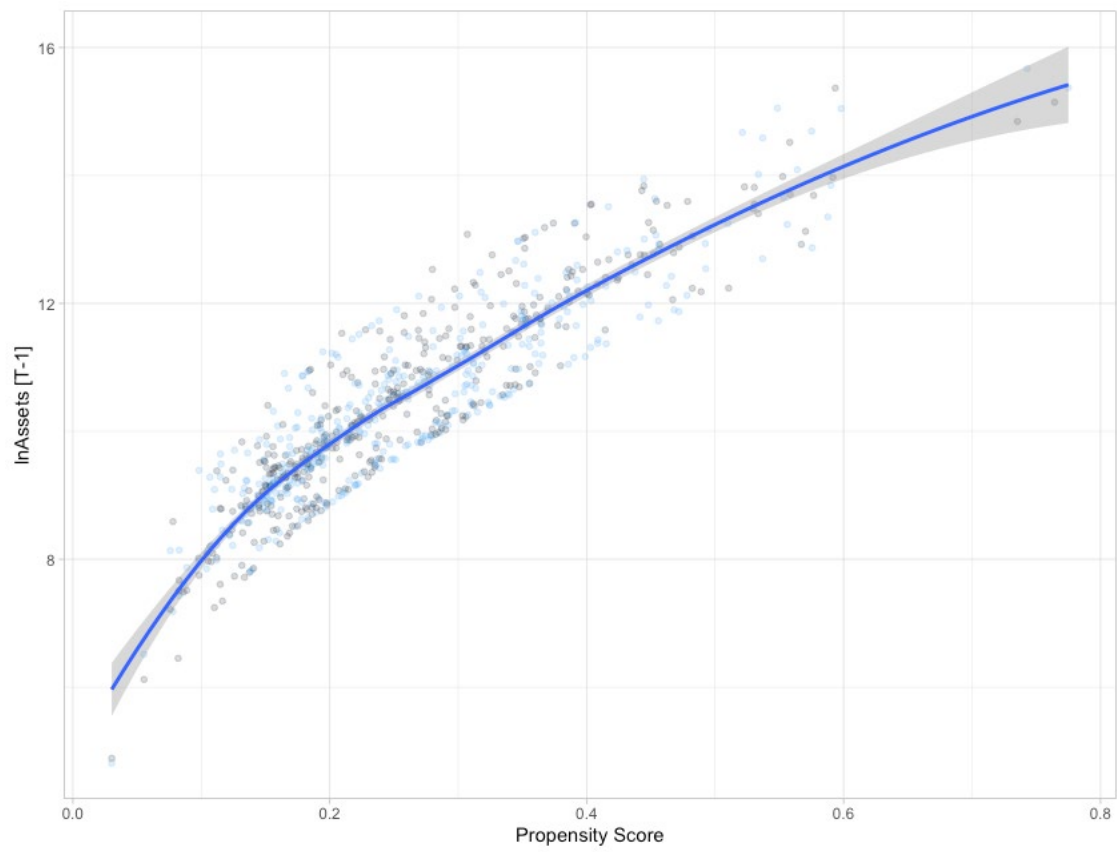
$$P(PE\ Buyout | FCF\ Margin_{T-1}, FCF\ Margin\ Quartile_{T-1}, FCF\ Quartile_{T-1},$$

$$\begin{aligned}
& \ln \text{Assets Quartile}_{T-1}, \text{Leverage Quartile}_{T-1}, \text{Sales Quartile}_{T-1}) \\
& = 1 - (1 + \exp (\beta_1 * \text{FCF Margin}_{T-1} + \beta_2 * \text{FCF Margin Quartile}_{T-1} + \\
& \beta_3 * \text{FCF Quartile}_{T-1} + \beta_4 * \ln \text{Assets Quartile}_{T-1} \\
& \quad + \beta_5 * \text{Leverage Quartile}_{T-1} + \\
& \beta_6 * \text{Sales Quartile}_{T-1} + \varepsilon))^{-1} \\
& \quad \quad \quad (\text{A4})
\end{aligned}$$

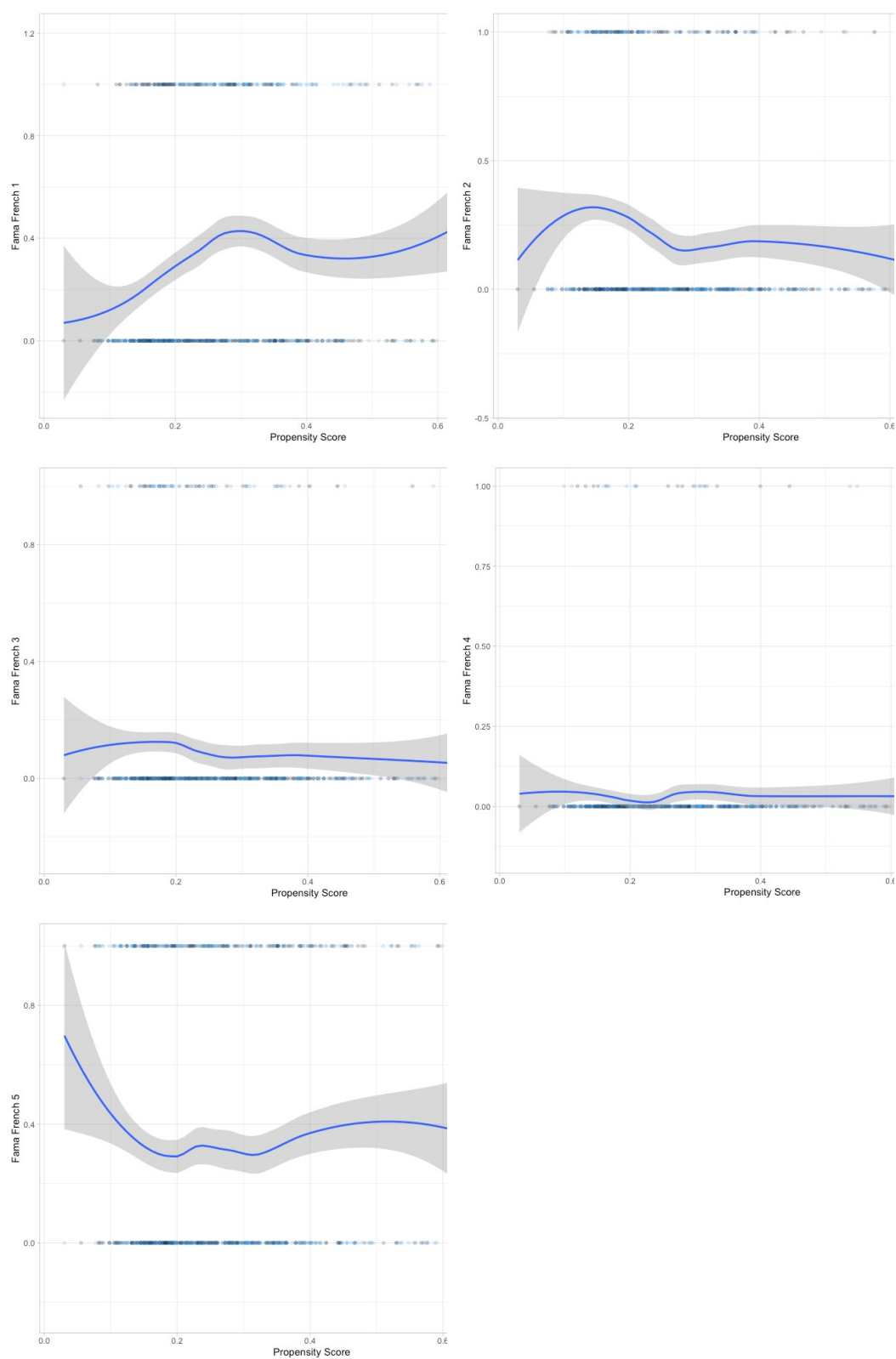
For model VI in *Table 4*, both equations (A3) and (A4) are combined, accounting for both EBITDA and FCF effects being reflected in buyout likelihood.

Appendix 11: Propensity Score Distribution on Buyout Probability

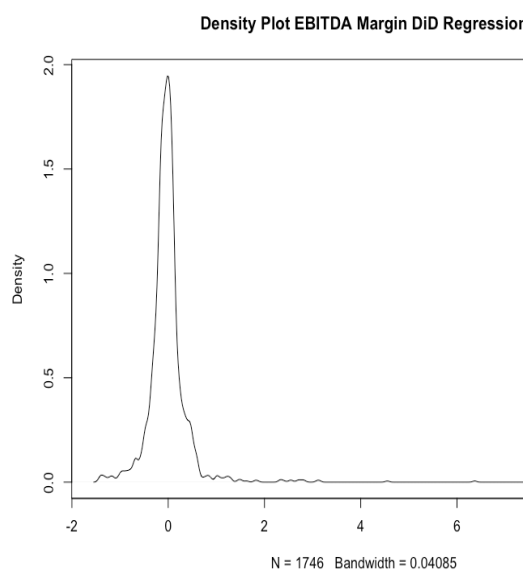
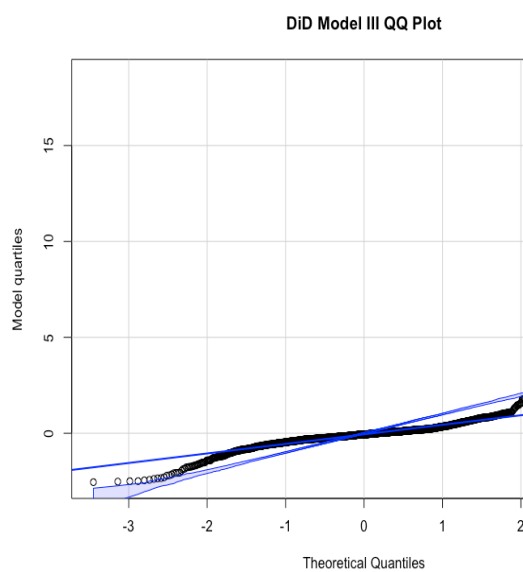
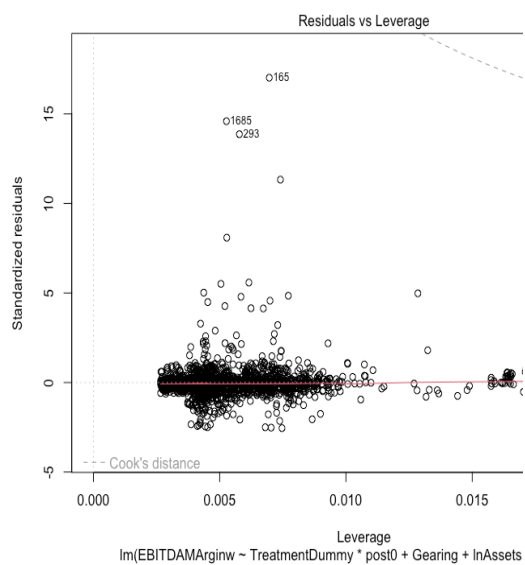
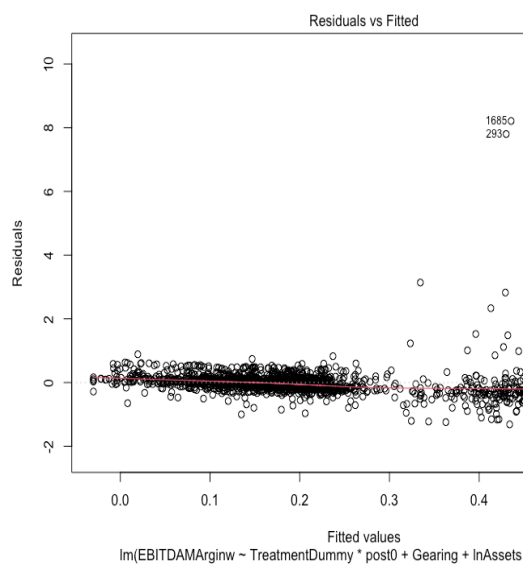




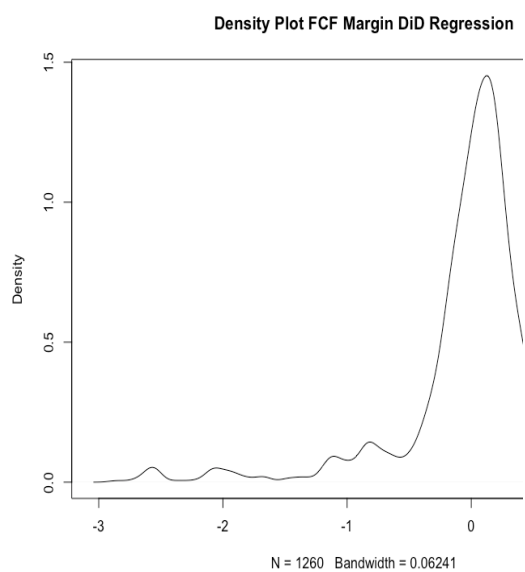
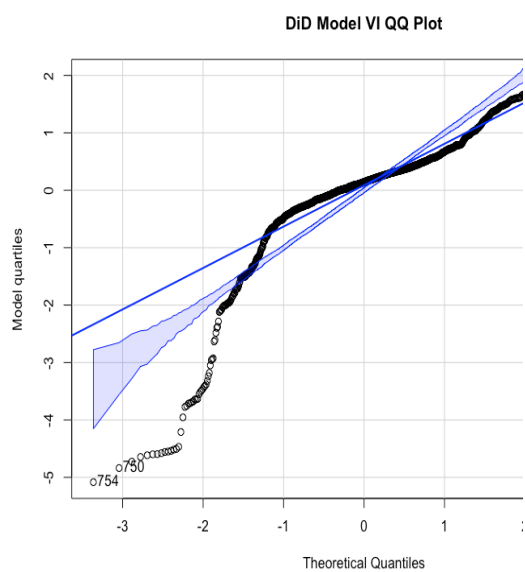
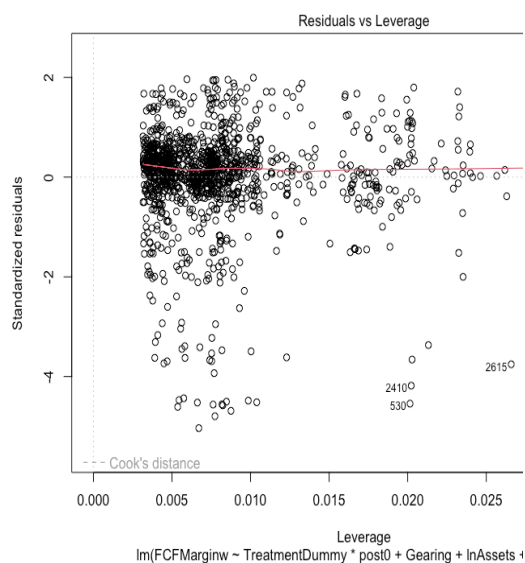
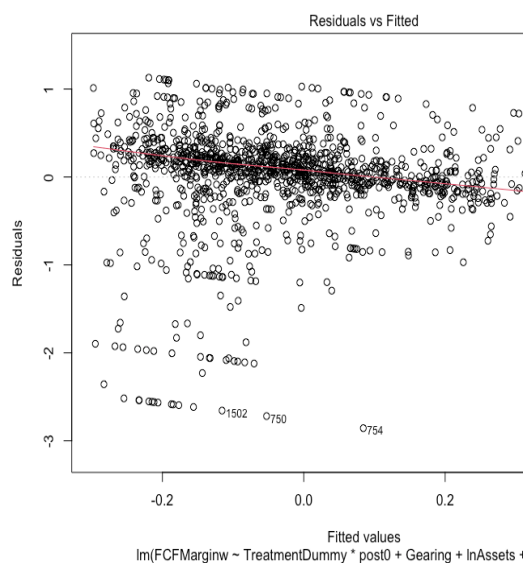
Appendix 12: PSM Estimation on Fama French Industry Classification



Appendix 13: Tests on Robustness and Sensitivity Analysis: EBITDA Margin DiD Regression Residuals



Appendix 14: Tests on Robustness and Sensitivity Analysis: FCF Margin DiD Regression Residuals



Appendix 15: Country-level Sensitivity Analysis on DiD Regression Models

TABLE A-5

DiD regression sensitivity analysis through **country level cross validation**. Every model excludes transactions from one country. On each subset the same DiD model is performed. Model I excludes AT, model II DE, model III FR, model IV UK, and model V IT. The regression is performed with EBITDA margin and FCF margin as the dependent variables, regression output for FCF margin is represented in *italics*.

The level of significance is represented by an asterix where the explanatory variables are statistically significant at a 0.1% (***), 1% (**), 5% (*), or 10% (x) confidence interval.

KPI	DiD Im Regression Models: Sensitivity Analysis				
	I	II	III	IV	V
Treatment	-0.20*** <i>-0.10</i>	-0.30*** <i>-0.13</i>	-0.30*** <i>-0.05</i>	-0.27*** <i>-0.06</i>	-0.28*** <i>-0.12</i>
Post Buyout	-0.26*** <i>-0.25**</i>	-0.24*** <i>-0.30***</i>	-0.28*** <i>-0.18^x</i>	-0.23*** <i>-0.23**</i>	-0.26*** <i>-0.25**</i>
Post Buyout Treatment	0.28*** <i>0.05</i>	0.26*** <i>0.09</i>	0.30*** <i>-0.08</i>	0.26*** <i>0.02</i>	0.24** <i>0.15</i>
Leverage	0.00** <i>0.00</i>	0.00*** <i>0.00</i>	0.00* <i>0.00*</i>	0.00* <i>0.00</i>	0.00 <i>0.00</i>
lnAssets	-0.02* <i>-0.07***</i>	-0.01 <i>-0.07***</i>	-0.02 <i>-0.06***</i>	-0.02** <i>-0.07***</i>	-0.04** <i>-0.05**</i>
R ²	5.62% <i>5.48%</i>	5.21% <i>6.22%</i>	4.93% <i>6.06%</i>	5.99% <i>5.61%</i>	5.74% <i>4.41%</i>
RSME	0.57 <i>0.57</i>	0.56 <i>0.58</i>	0.63 <i>0.56</i>	0.47 <i>0.56</i>	0.59 <i>0.54</i>
n	785	691	605	551	556

Appendix 16: Industry-level Sensitivity Analysis on DiD Regression Models

TABLE A-5

DiD regression sensitivity analysis through **industry level cross validation**. Every model excludes transactions from one industry. On each subset the same DiD model is performed. Model I excludes FF1, model II FF2, model III FF3, model IV FF4, and model V FF5. The regression is performed with EBITDA margin and FCF margin as the dependent variables, regression output for FCF margin is represented in *italics*. For all models, I also controlling for Fama French industry classification, buyout year, and country.

The level of significance is represented by an asterix where the explanatory variables are statistically significant at a 0.1% (***), 1% (**), 5% (*), or 10% (x) confidence interval.

KPI	DiD Im Regression Models: Sensitivity Analysis				
	I	II	III	IV	V
Treatment	-0.23*** <i>-0.03</i>	-0.31*** <i>-0.03</i>	-0.26*** <i>-0.07</i>	-0.31*** <i>-0.08</i>	-0.40*** <i>-0.07</i>
Post Buyout	-0.16*** <i>-0.02**</i>	-0.27*** <i>-0.26**</i>	-0.19*** <i>-0.24**</i>	-0.26*** <i>-0.26***</i>	-0.35*** <i>-25**</i>
Post Buyout Treatment	0.24*** <i>0.03</i>	0.32*** <i>0.04</i>	0.23*** <i>0.04</i>	0.30*** <i>0.07</i>	0.37*** <i>0.06</i>
Leverage	0.00** <i>0.00</i>	0.00* <i>0.00</i>	0.00** <i>0.00</i>	0.00** <i>0.00</i>	0.00** <i>0.00</i>
lnAssets	-0.01 <i>-0.06***</i>	-0.03* <i>-0.07***</i>	-0.02 ^x <i>-0.07***</i>	-0.03** <i>-0.07***</i>	-0.03* <i>-0.06***</i>
R ²	5.19% <i>6.11%</i>	6.43% <i>7.18%</i>	6.02% <i>7.48%</i>	6.96% <i>7.02%</i>	9.75% <i>6.49%</i>
RSME	0.57 <i>0.61</i>	0.60 <i>0.60</i>	0.52 <i>0.56</i>	0.67 <i>0.55</i>	0.58 <i>0.52</i>
n	563	622	703	771	529