FIE401 - First assignment
M&A and Method of Payment

Group 08

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Abstract

In this report we intend to answer the research question: "Do mergers destroy value for bidder shareholders depending on the method of payment?" We have used the provided file "CAR_M&A.Rdata" which contains 5154 deals over a period from 1990 to 2014 to investigate the impact of payment method. Our findings on this topic are that when a bidding company fully uses stocks as currency for acquisitions it receives a negative announcement effect on the wealth if the target company is a public company. In contrast, the effect tends to be the opposite when the target company is private.

Exploratory analysis and outlier detection

Table 1: Summary statistics

Statistic	Min	Pctl(25)	Mean	Pctl(75)	Max	St. Dev.
deal_value	1.000	19.593	835.173	341.445	164,746.900	4,418.937
carbidder	−0.590	−0.042	0.009	0.055	1.368	0.116
bidder_size	400.500	144,881.700	5,154,525.000	2,388,443.000	432,000,000.000	19,739,995.000
sigma_bidder	0.007	0.022	0.037	0.045	0.280	0.023
run_up_bidder	0.238	0.820	1.191	1.332	4.688	0.692
relsize	0.010	0.047	0.373	0.371	12.170	0.850
bidder_mtb	0.324	1.387	2.867	3.070	58.041	3.475
bidder_fcf	−1.193	−0.011	−0.011	0.086	0.253	0.215
bidder_lev	0.000	0.002	0.155	0.260	0.747	0.176

Table 1 presents summary statistics of the dataset. Even a simple summary of the data shows that there are outliers in the data, for example by large differences in mean and median or between maximum value and 3rd quantile. Outliers are a significant problem in empirical research because they can cause biased regression coefficients. Two obvious outliers from the summary are deal value and bidder size.

There are statistical tools to find outliers, one of the most famous methods in regression setting is Cook's distance, which basically is a summary on how much the regression outcome changes when specific observations are removed. We however will rely on plots, which is also a good way to find outliers in the data. In this case we plotted a scatterplot of the variable to see whether observations are distant from others. This can be clearly seen with the deal value and bidder size. Overall, there seem to be other "smaller" outliers.

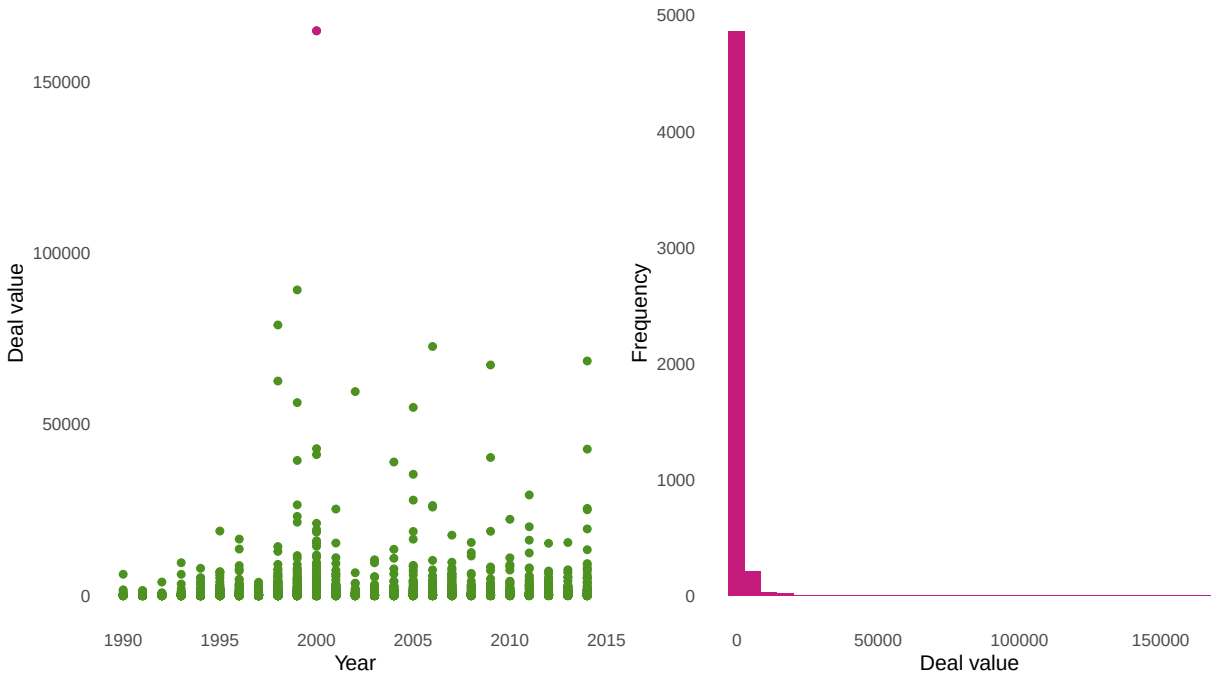


Figure 1: Scatterplot and histogram of deal value

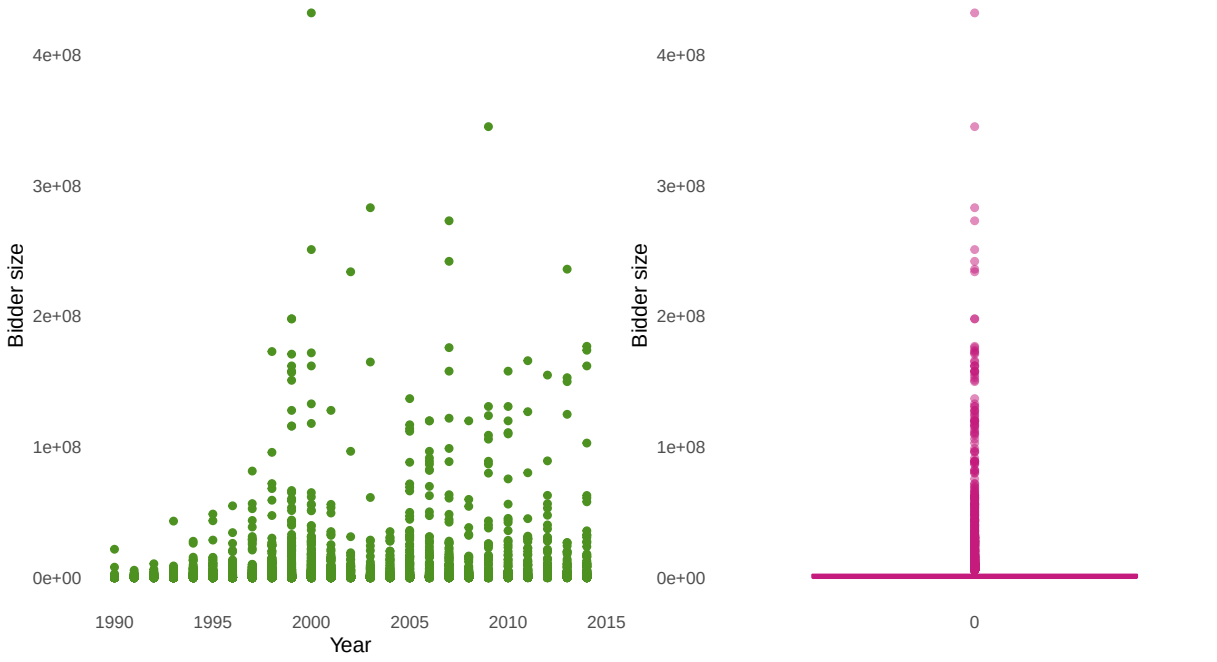


Figure 1 demonstrates that the distribution of the deal value variable is highly skewed. As the values are non-negative, we use log-transformation to correct it. Similar pattern with a number of extremely high values can be observed in bidder size variable, demonstrated by **Figure 2**. We correct it we using log-transformation as well. **Figure 4** demonstrates how log-transformation affects the distribution of the deal value variable. **Figure 3** shows a spike in bidder book-to-market ration, which could be a potential error in the data, however we believe the reason for high values only in year 2000 is the dotcom bubble.

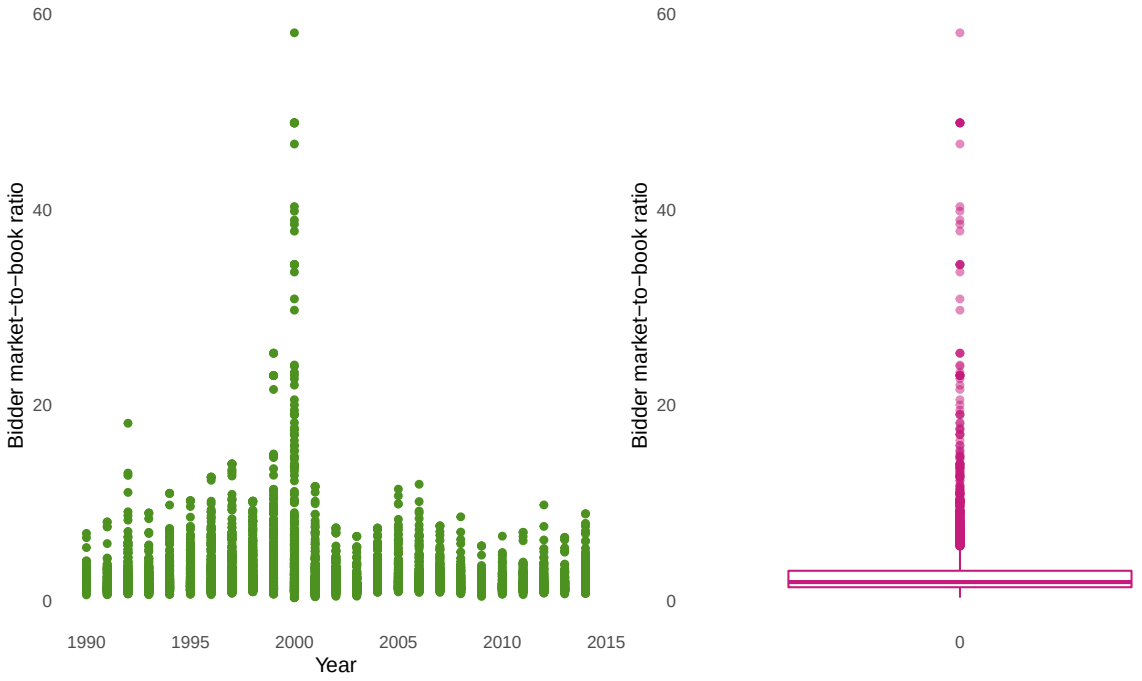
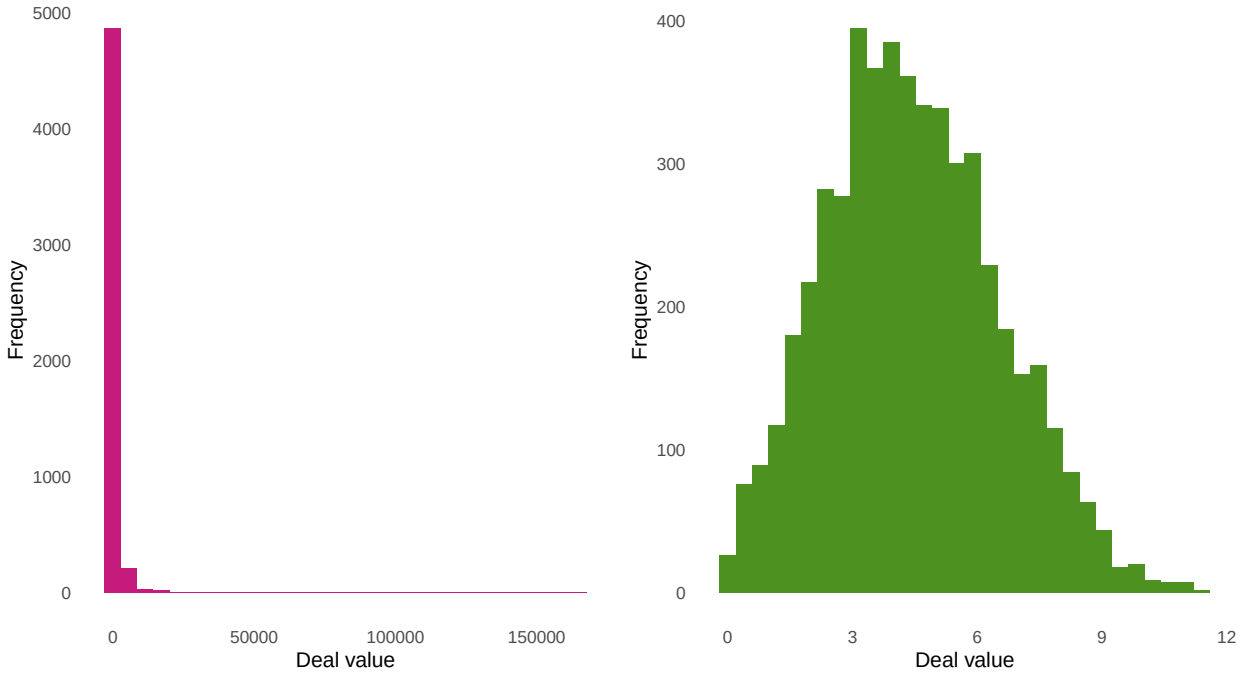


Figure 2: Scatterplot and boxplot of bidder book-to-market ratio



Descriptive table 1

Table 2: Mean values: time effects

	year	avg_deal_size	avg_bidCAR	avg_share_private	avg_share_stock
1	1990	3.303	-0.009	0.448	0.478
2	1991	3.183	0.042	0.612	0.515
3	1992	3.16	0.029	0.719	0.597
4	1993	3.146	0.042	0.673	0.491
5	1994	3.663	0.021	0.59	0.556
6	1995	3.823	0.013	0.581	0.578
7	1996	4.057	0.021	0.58	0.589
8	1997	4.298	0.019	0.538	0.54
9	1998	4.409	0.008	0.5	0.5
10	1999	4.797	0.013	0.468	0.522
11	2000	4.851	-0.017	0.544	0.529
12	2001	4.604	-0.021	0.394	0.389
13	2002	4.082	-0.012	0.503	0.284
14	2003	4.381	0.02	0.485	0.263
15	2004	4.487	-0.001	0.551	0.177
16	2005	4.892	-0.004	0.571	0.171
17	2006	5.047	0.006	0.51	0.161
18	2007	5.047	0	0.515	0.102
19	2008	4.691	0.001	0.598	0.165
20	2009	4.956	0.003	0.45	0.2
21	2010	5.192	0.007	0.437	0.118
22	2011	5.313	-0.005	0.612	0.095
23	2012	5.429	0.03	0.491	0.069
24	2013	5.384	0.029	0.57	0.112
25	2014	5.197	0.023	0.562	0.171

Table 2 displays the average deal size, carbidder, share of deals with private firms, and share of deals fully paid in stock per year in the data. Key insights in this table:

- The average deal size went up in the period. Especially in 2014. This can indicate some extreme values that should be winsorized out. But is also to some extent expected because of economic growth.
- The abnormal returns have varied from –0,0212 to 0,0425. Returns have a straightforward effect on wealth, therefore give good information about research questions about the wealth of bidder shareholders
- The share of deals with private targets have had a relatively stable percentage over the period under investigation.
- The biggest change in the table is the share of deals fully paid in stock. This share was stable from 1990-1999 (around 50%), but from 1999-2014 we see a steep decrease in this share. The period ended in just 17%. This is beneficial to find an insight of the methods of payment and answer that research question.

Descriptive table 2

Table 3 and **Table 4** present the results of the t-tests on mean of two group: all stock and not all stock.

- All variables but carbidder,horz and relsize are statistically significant. Meaning the hypothesis that the difference between observations with all.stock and observations with not all.stock equals zero can be rejected for all but these 3 variables
- It gives a hint that there are differences all.stock mergers before the regression analyis

Table 3: Difference in means between all stock and not all stock

	year	deal_value	public	tender_offer	carbidder	bidder_size	sigma_bidder
all.stock	1,998.193	4.124	0.444	0.023	0.008	12.994	0.044
not.all.stock	2,002.481	4.647	0.474	0.167	0.010	13.489	0.032
differece	-4.288	-0.523	-0.030	-0.144	-0.002	-0.495	0.011
p-value, t-test	0	0	0.034	0	0.635	0	0

Table 4: Difference in means between all stock and not all stock - continued

	run_up_bidder	hostile	horz	relsize	bidder_mtb	bidder_fcf	bidder_lev
all.stock	1.310	0.003	0.361	0.382	3.820	-0.044	0.122
not.all.stock	1.115	0.012	0.374	0.367	2.258	0.010	0.176
differece	0.195	-0.009	-0.013	0.015	1.562	-0.054	-0.054
p-value, t-test	0	0.0001	0.363	0.533	0	0	0

Regression

Correlation Plot

Figure 5 shows the correlations between variables. The correlation between bidder size and deal value is high relative to many of the other observations. As bigger firms tend to have higher incomes and sometimes larger cash reserves, they can also buy other big firms, resulting in higher values on deals. The variables "public" and "private" have a highly negative correlation mainly due to the fact that they represent the direct opposite of each other.

Regression table

Table 5 presents results of 6 linear regressions. - Variable all_stocks always statistically significant on 1% level.

- Also economically significant, if payment procedure is done by buying all stocks (all_stocks=1) then abnormal return of bidder increases by 0,014 (1,4%), which makes a difference with big numbers in play.
- Looking at regressions 5 and 6 we see that different effect of all_stocks, this shows that it makes a difference whether we look at public companies or private companies.
- Therefore regression 6 is our best model in explaining the effect of all_stocks
- However, we are not too confident that this result is unbiased, probably omitted variable bias is still a problem. We would industry fixed effects.

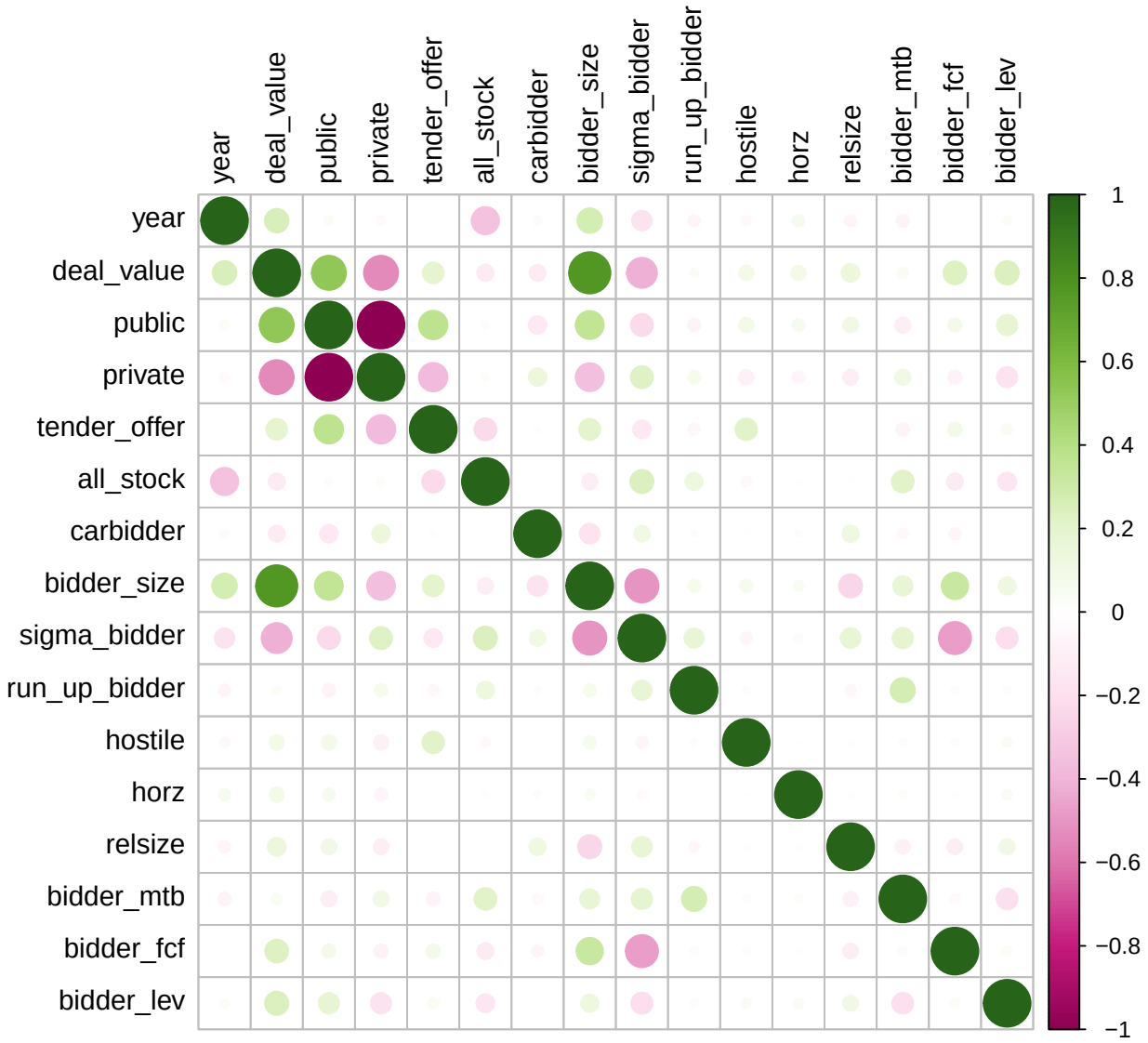


Figure 3: Correlation plot

Table 5: Regressions output

	Dependent variable:					
	carbidder					
	(1)	(2)	(3)	(4)	(5)	(6)
all_stock	0.014^{***}	-0.023^{***}	0.014^{***}	0.012^{**}	-0.014^{***}	0.016^{***}
	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
public			-0.019^{***}			-0.018^{***}
			(0.004)			(0.005)
I(all_stock ∗public)			-0.037^{***}			-0.040^{***}
			(0.007)			(0.007)
deal_value				0.012^{***}	-0.006^{***}	0.004^{**}
				(0.003)	(0.002)	(0.002)
bidder_size				-0.015^{***}	-0.001	-0.008^{***}
				(0.002)	(0.002)	(0.002)
bidder_mtb				-0.0002	-0.002^{**}	-0.001^{**}
				(0.001)	(0.001)	(0.001)
run_up_bidder				0.002	-0.008^{**}	-0.002
				(0.003)	(0.004)	(0.002)
bidder_fcf				0.006	-0.001	0.004
				(0.011)	(0.013)	(0.008)
bidder_lev				-0.001	0.037^{***}	0.014
				(0.015)	(0.012)	(0.010)
sigma_bidder				0.269^{**}	-0.275^{*}	0.236^{**}
				(0.125)	(0.149)	(0.095)
relsize				0.023^{***}	0.001	0.011^{***}
				(0.004)	(0.003)	(0.002)
horz				-0.001	-0.002	-0.003
				(0.005)	(0.004)	(0.003)
tender_offer				0.013	0.010^{**}	0.014^{**}
				(0.044)	(0.005)	(0.006)
year				-0.0004	0.001^{***}	0.0002
				(0.0004)	(0.0004)	(0.0003)
hostile					0.001	-0.004
					(0.015)	(0.018)
Constant	0.019^{***}	0.00003	0.019^{***}	0.854	-1.975^{***}	-0.320
	(0.003)	(0.003)	(0.003)	(0.877)	(0.729)	(0.586)
Observations	2,769	2,384	5,153	2,769	2,384	5,153
Adjusted R^2	0.003	0.013	0.026	0.085	0.040	0.061

Note: *p<0.1; **p<0.05; ***p<0.01
Models (1) and (4) contain subsample consisting of only private;
models (2) and (5) contain subsample consisting of only public.

- We have adjusted R^2 ranging from 0,003-0,085. A low adjusted R^2 indicated that our models does not explain much of the variation in carbidder return. If we had a relatively high R^2 (70%<), we would be able to construct an almost perfect event in which we maximized carbidder abnormal return. Since there are several factors included her, and a few other variables that could cast a light on the research question, a low adjusted R^2 is reasonable, and thus indicates that our models are consistent with reality and literature
- We think we found a relevant effect of interest but would still be completely confident about it. For example, we would have liked to include an industry variable.
- From regression 3 we discover that if the deal is done in all stocks, the carbidder abnormal return increases by 1,4%. If the deal is done in all stock, and with a public company, this increase is neutralized by a decrease on 1,9% from the public company. This is supported by the signal effect, where if a company is set to by a large percentage, or a company in its entirety, the Share price will go up as a result of a signal that the company is doing well, and a lack of shares available in the market. This will then again result in higher total price for the "carbidder". This supports the research question that the payment method has an effect on carbidder value.

Additional Questions

Questions 1

Can you include both a dummy for private and public targets in the regression? We cannot include both dummy variables in the regression, as we will encounter the "dummy variable trap". The dummy variable trap is when two or more variables created by on-hot encoding are highly correlated. This causes perfect multicollinearity, which means that we can't measure the betas correctly. Multicollinearity appears when one or more independent variables can be written as a perfect linear combination of one or more of the independent variables. The solution is by omitting one of the dummy variables. Alternatively, if we do want to estimate both betas, a potential solution would be to omit the intercept term.

Question 2

If you limit the sample to private deals, what's the coefficient on the hostile variable? If we limit the sample to private deals, the coefficient on the hostile variable will be zero. A hostile takeover can only happen to a public company. In a hostile takeover, the acquirer attempts to take over a company (the target company) against the wishes from the management in the target company. This can be done by going directly to the target company's shareholders or fight to replace the management.