Corporate Valuation, Restructuring and M&A's

Returns to Mergers

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What are the Returns to Mergers?

We can use this table to separate between the theories

Theory	Combined Gains	Gains to Target	Gains to Bidder
Economies of Scale / Synergies	positive	positive	nonnegative
Transaction Cost Efficiency	positive	positive	nonnegative
Disciplinary Effects	positive	positive	nonnegative
Agency Costs	negative	positive	more negative
Managerial Entrenchment	negative	positive	more negative
Hubris	zero	positive	negative
Breach of Trust	positive	positive	nonnegative

But... How do we measure **abnormal returns**?

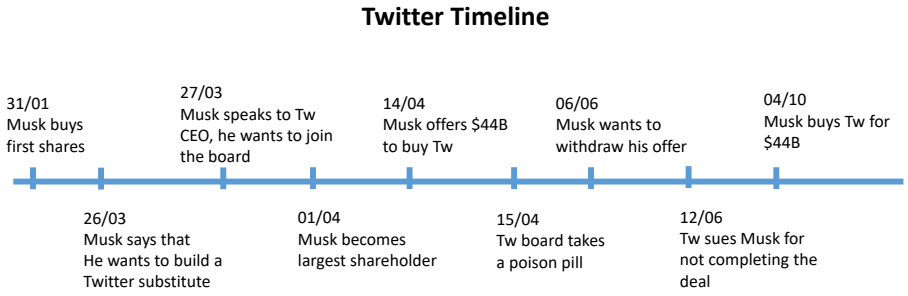
Measuring Abnormal Returns-Summary

0. Determine the event announcement date
1. Choose an event window to examine the effect
2. Calculate normal returns for each day and each firm
3. Calculate the abnormal return (residual return)
    - Take the average of residuals if there are multiple firms
4. Calculate the cumulative abnormal return (CAR)
5. Test whether the CAR is statistically significant

Measuring Abnormal Returns

1. The announcement date is defined as date 0
   - Should be the first release of public information – not easily obtainable
   - Business press is a good source of information (Wall Street Journal Index, Financial Times)
   - Read newspaper articles and identify the date
2. Determining the announcement date can be tricky

   → Ex: Twitter



Measuring Abnormal Returns

2. Choose an event window to examine the effect
   - Studies normally select a window like -40, 40
   - 40 days before announcement until 40 days after announcement
   - A longer window may capture more of the event
     $\rightarrow$ E.g., insiders may have been trading before date -40 and the event may not have ended at +40
   - A longer window may entail statistical problems
     $\rightarrow$ Essentially we are comparing the returns of the company to "normal" returns. Are they higher than normal (i.e., abnormal)?
     $\rightarrow$ If "normal" returns are measured with error then a longer window will compound this error
   - The chosen window needs to strike a balance between these two issues

Measuring Abnormal Returns

3. Calculate normal returns, $\hat{R}_{jt}$, for each day t and for each firm j

- What is a normal return?
  $\rightarrow$ The return if the event did not happen
- Three methods for calculating normal returns
  1. Mean-adjusted return
  2. Market model method
  3. Market-adjusted return

Measuring Abnormal Returns

- Mean-adjusted return

1. Choose a "clean" period. Should be before the event. It cannot include the event period. For example (if event period is -40 to +40) then the clean period could be -240 to -41.
2. The predicted return for a firm in the event period is the average of return in the clean period

$$\hat{R}_{jt} = \overline{R}_j = \frac{\sum_{t=-240}^{-41} R_{jt}}{200} \tag{1}$$

3. The residual return is the difference between the realized return and $\overline{R}_j$

$$r_{jt} = R_{jt} - \hat{R}_{jt} \tag{2}$$

4. Abnormal return is the average of residuals (if there are several events/firms)

$$AR_t = \frac{\sum_j r_{jt}}{N} \tag{3}$$

Measuring Abnormal Returns

- Market model method

1. Choose a "clean" period
2. Estimate the market model using ordinary least squares (OLS):

$$\hat{R}_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt} \tag{4}$$

   where R_{mt} is the return on a market index for day t
   β measures the sensitivity of firm j to the market
   α measures the mean return over the period not explained by the market
   ε_{jt} is the error term
3. Estimate the regression and obtain $\hat{\alpha}$ and $\hat{\beta}$
   $\rightarrow$ We may want to improve estimates of $\hat{\beta}$ by shrinking the estimate towards 1 (the average)
   $\rightarrow$ Example of adjustment: adjusted beta = unadjusted beta $\times\mu + (1 - \mu)$. Bloomberg adjustment $\mu = 0.66$

Measuring Abnormal Returns

- Market model method – contd

3. Use $\hat{\alpha}$ and $\hat{\beta}$ to estimate the normal return

$$\hat{R}_{jt} = \hat{\alpha} + \hat{\beta} \times R_{mt} \tag{5}$$

4. Then calculate the residual

$$r_{jt} = R_{jt} - \hat{R}_{jt} \tag{6}$$

5. Again, abnormal return is the average of residuals

- The market model has the advantage that it takes into account the risk associated with the market and mean returns
- Most widely used method of calculating normal returns

Measuring Abnormal Returns

- Market adjusted return

1. The predicted return on a stock is the return on the market that day
2. That is

$$\hat{R}_{jt} = R_{mt} \tag{7}$$

- Note that this is like using the market model but assuming that $\hat{\alpha} = 0$ and $\hat{\beta} = 1$ for all firms.
- This is a quick and dirty approximation that works fairly well

Measuring Abnormal Returns-An Example

Choose the event: ASML acquired Cymer in 2013

- What is ASML?
- It is arguably the one of the most important companies for the current human civilization
- Why? Because ASML produces a crucial product
- We all know that chips matter for our technology
  $\rightarrow$ You may have heard global shortage in chips and how this distorts the overall economy
- Chip production is a difficult process, which entails the highest rigor and care
- When we think about chip producers, a few companies come to our minds: Intel, Samsung, TSMC, etc.

Measuring Abnormal Returns-An Example

- ASML produces machines that chip manufacturers use to produces chips
- These machines use light to engrave integrated circuits onto silicon wafers
- ASML has the largest market share (62%)
- In addition, it has the developed a new state-of-the-art technology (EUV lithography), which makes ASML a monopoly
- ASML's market capitalization has grown tenfold in the last decade, reflecting its success

Measuring Abnormal Returns-An Example

- Its recent success does not mean that there are no challenges
- As many other firms, ASML relies on numerous suppliers
  → Approximately 5000 suppliers
  → Carl Zeiss-optics
  → VDL-robotic arms
  → Cymer-light source
- Due to its dominance in the market, it is not easy to convince the suppliers to make the investment for a new technology
- If ASML changes its mind and decides not to use the new technology, there is no other possible buyers in the market
- What are the possible options for ASML?

Measuring Abnormal Returns-An Example

- Cymer is headquartered in San Diego, CA and produces light sources, which is crucial for the EUV lithography that ASML is working on
- The problem with EUV lithography was that the process was slower than expectations of the market and investors
- As Cymer produces a vital component for the new technology, acquiring it may facilitate the development
  $\rightarrow$ "The purpose of the acquisition of Cymer is to accelerate the development of EUV semiconductor lithography technology... Combining Cymer's expertise in EUV light sources with ASML's expertise in lithography systems design and integration will reduce the risk and accelerate the introduction of this extremely complex technology."
- ASML made the announcement on 17 October 2012

Measuring Abnormal Returns-An Example

Details of the Deal: Cash-and-shares acquisition

- 2.5bil$ $\rightarrow$ 630mil$ cash & 1890mil$ worth of ASML shares
  - 25% cash, 75% shares
  - Each Cymer share gets 20$ in cash and 1.1502 ASML shares
- The deal's value creates a 61% premium on Cymer's market value.
- Is it a bad deal?
  - EUV was risky-nobody knows whether it is possible to develop this tech
  - A big premium
  - It could enable ASML to produce the new technology
- Now, we look at the effect of this announcement on ASML's and Cymer's stock returns

Measuring Abnormal Returns-An Example

- The event date is 17 October 2012
- We need to choose event window and estimation window
- Event window: [-40, 40]
  Estimation window: [-240, -41]
- Prepare the data
- We have the all ingredients, now we can dive into calculations
- 3 methods to calculate residual return: Mean-adjusted return, Market model method, and market-adjusted return
- Residual return: $r_{jt} = R_{jt} - \hat{R}_{jt}$ (actual stock return- benchmark return)
- Let's start with mean-adjusted return

Mean-adjusted return

- Estimation window: [-240, -41]
- Calculate the mean returns over estimation window

$$\hat{R}_{jt} = \overline{R}_j = \frac{\sum_{t=-240}^{-41} R_{jt}}{200} \tag{8}$$

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	ASML (Acquirer)	Cymer (Target)
Mean return (%)	0,207	0,208

ASML&Cymer

- Mean-adjusted return method takes the return mean over the estimation period as the benchmark return
- Therefore, residual return is the difference between the realized return and the mean
- Calculate residual return for each day

Date	ASML	Residual return	Cymer	Residual return
-40	0,93%	0,93-0,207=0,725	-2,51%	-2,51-0.28=-2.717
-39	0,62%	0,62-0,207=0,409	-0,68%	-0.68-0.208=0.885
.	.	.	.	.
39	1,50%	1,50-0,207=1,293	0,74%	0.74-0.208=0.530
40	-0,06%	-0.06-0.207=-0,267	-0,23%	-0.23-0.208=-0.433

- Then, we calculate the cumulative abnormal returns (in the coming slides)

Market Model

- Estimation window: [-240, -41]
- Estimate the market sensitivity of ASML/Cymer with OLS

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt} \tag{9}$$

$\hat{\alpha}_{ASML} = 0.0011$, $\hat{\beta}_{ASML} = 1.37$, $\hat{\alpha}_{Cymer} = 0.0010$, $\hat{\beta}_{Cymer} = 1.43$

- Calculate the residual return

$$r_{jt} = R_{jt} - (\hat{\alpha}_j + \hat{\beta}_j R_{mt}) \tag{10}$$

Date	ASML	Residual return	Cymer	Residual return
-40	0,93%	0,93%-(0.0011+(1.37×-0.23%))=1.14%	-2,51%	-2,51%-(0.0010+(1.43×-0.23%))=-2.28%
-39	0,62%	0,62%-(0.0011+(1.37×-0.01%))=0.52%	-0,68%	-0.68%-(0.0010+(1.43×-0.01%))=-0.76%
.	.	.	.	.
39	1,50%	1.50%-(0.0011+(1.37×-0.31%))=1.81%	0,74%	0.74%-(0.0010+(1.43×-0.31%))=1.08%
40	-0,06%	-0.06%-(0.0011+(1.37×1.02%))=-1.57%	-0,23%	-0.23%-(0.0010+(1.43×1.02%))=-1.78%

- Again, we calculate the cumulative abnormal returns in the next step (in the coming slides)

Market adjusted model

- Estimation window: [-240, -41]
- This method uses the market return as the benchmark
  $\rightarrow$ Like using the market model but assuming that $\hat{\alpha} = 0$, $\hat{\beta} = 1$
- The residual return is $r_{jt} = R_{jt} - R_{mt}$

Date	ASML	Residual return	Cymer	Residual return
-40	0,93%	0,93%-(-0.23%)=1.16%	-2,51%	-2,51%-(-0.23%)=-2.28%
-39	0,62%	0,62%-(-0.01%)=0.63%	-0,68%	-0.68%-(-0.01%)=-0.67%
.	.	.	.	.
39	1,50%	1.50%-(-0.31%)=1.81%	0,74%	0.74%-(-0.31%)=1.05%
40	-0,06%	-0.06%-(1.02%)=-1.08%	-0,23%	-0.23%(-1.02%)=-1.25%

- Then, cumulative abnormal returns (in the next slide)

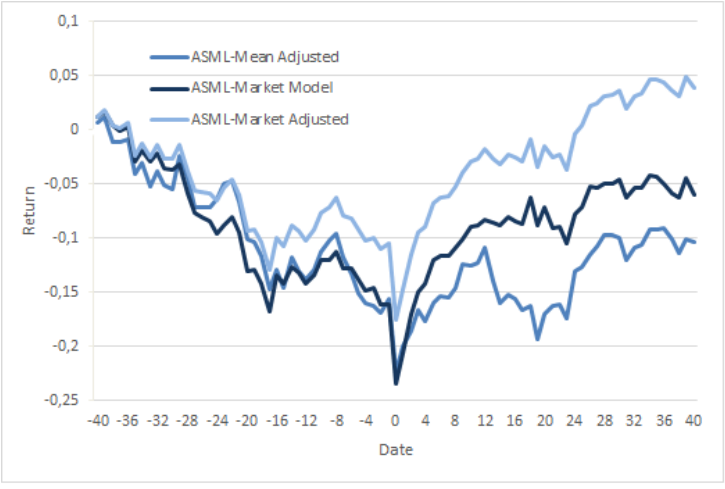
Cumulative abnormal returns

- CARs are the sum of the residuals over the event window (ie: [-40, 40])
- Below we have CAR for ASML-Market model

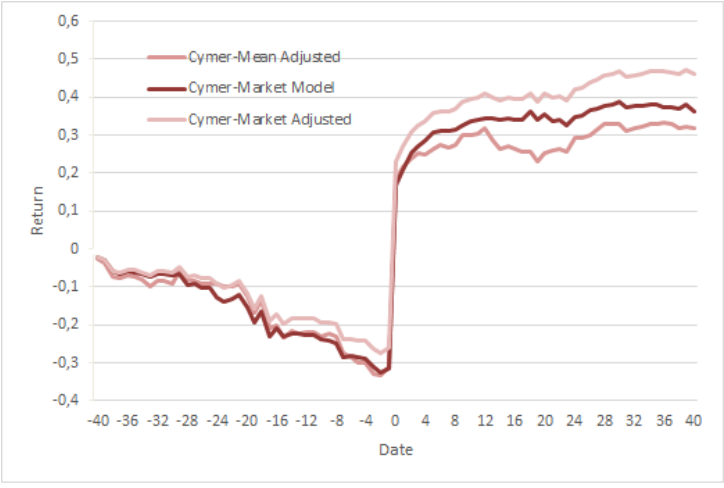
Date	Residual	CAR
-40	1,14%	1,14%
-39	0,52%	1,66%
-38	-1,21%	0,45%
.	.	.
39	1,81%	-4,42%
40	-1,57%	-5,99%

- Good place to plot graphs

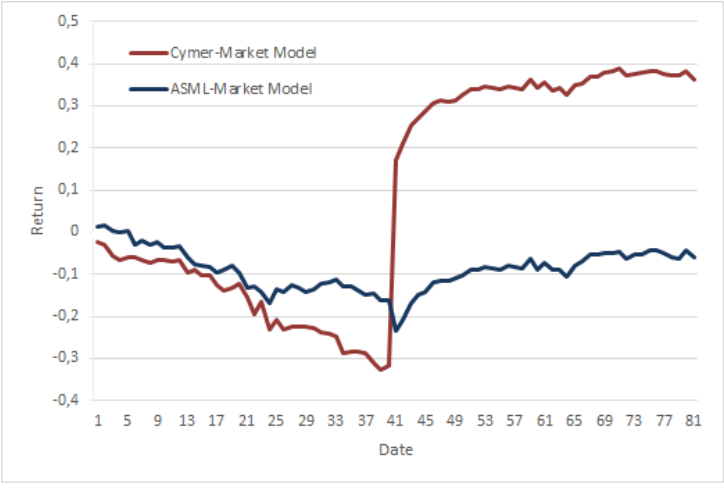
ASML CARs-3 methods



Cymer CARs-3 methods



ASML and Cymer CARs-Market model



Testing for Statistical Significance

- Can we infer with a certain level of confidence that the residuals are significantly different from zero?
- If returns are normally, identically and independently distributed, then

$$\frac{r_{jt}}{\hat{S}_j} \tag{11}$$

  has a t-distribution, where r is the residual and s is the standard error, t is a time index and j is a firm index
- We see that ASML's CAR is statistically insignificant and Cymer's CAR is significant at 1 percent (except Mean Adjusted method)

What are the Returns to Mergers?

- In this example, we see that the bidder does not have positive CAR but the target has
- This is only one example
- Let's look at the literature to see the systematic findings