
INDEX REVISIONS AND STOCK RETURNS
stonks

AGENDA

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B. **Introduction**
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EXECUTIVE SUMMARY

Based on previous work regarding inclusion effects in the S&P500, we analysed the German DAX to see if the same effects can also be observed. Our analysis addresses the inclusion effects of three areas: **short term effects**, **market correlation** and **systematic risk**.

DATA BASIS

Historical data of all companies in the DAX from 01.01.2008 until 01.03.2022. Inclusion and exclusion information was obtained from the Deutsche Börse. Data was interpolated and scanned for outliers.

SHORT TERM EFFECTS

47% ↑

Increase in vol.

Trading volume increases after an addition to the DAX. In contrast to our expectations returns and return volatility did not increase. However, these results should be treated with care since the small sample size might be a reason for non significant results.

MARKET CORRELATION

0.00 –

Corr. delta

We analysed the change in correlation of every stock with the market for their inclusion/exclusion and announcement date, being aware that multicollinearity affects our results. Due to the small sample size we could not detect any reasonable effects.

SYSTEMATIC RISK

0.23 ↑

Increase in beta

After analysing the systematic risk for DAX stocks that were included/excluded from the index, we can confirm previous findings regarding the increase/decrease in the β-coefficients. Especially after the DAX30 to DAX40 increase, we see a steep increase in beta.

INTRODUCTION

BACKGROUND

Lawrence Harris et al.

The authors examined in their publication from 1986 the **Price & Volume Effects** of new inclusions into the S&P 500. Their key findings were:

- Immediately after an addition is announced, **prices increase** by more than **3 percent**
- This increase is nearly **fully reversed** after 2 weeks.

William B. Elliott et al.

In 2006, Elliott and his peers, wanted to understand **what Drives the Inclusion Effect** discovered in earlier papers. Their key findings were:

- Increased **investor awareness** is the primary factor behind the abnormal announcement returns
- Around the inclusion date **price pressure** can be observed
- No evidence that **anticipated improvements** in operating performance, or **increased liquidity** are related to the announcement or inclusion returns

Hypothesis: Similar to the S&P 500 we would expect to observe the same inclusion effects in Germany in the DAX. Furthermore, we anticipate changes in the correlation with the DAX as well as changes in the systematic risk after a DAX inclusion.

Note: As the DAX is way smaller than the S&P500 the sample size for new inclusions is also smaller and might be a potential pitfall in our analysis.

DATA BASIS

Reuters (Datastream)

The historical data for all companies that have been in the DAX was downloaded via Datastream from Reuters[1]

- **Time horizon**: 01.01.2008 – 01.03.2022. Due to mergers or bankruptcies data further back was not accessible with our Reuters access rights
- **Adjusted Close**
- **Daily Volume**
- Data was **splined** and analysed for **outliers**. Wirecards data for volume was interpolated linearly because too many data points were missing

Puma AG[2]

Date	Adj. Close	Volume
01.01.2008	27,326	323150
…	…	…
01.03.2022	76,44	815822

Inclusions and Exclusions

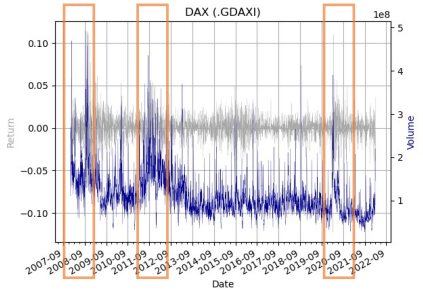
The **Deutsche Börse** provides an official list with all inclusions into the DAX over the years:

- The first exchange in the scope of our analysis was the replacement of Salzgitter AG with Heidelberg Cement AG on 21.06.2010
- Since 2010, over 22 companies have been introduced to the DAX. Usually around 1 exchange per year.
- 10 companies got excluded from the DAX
- The biggest change was the increase from 30 to 40 companies in September 2021

[1]Due to mergers, MAN and METRO were excluded [2]Data of Puma also from 2008 on, even though the inclusion was only in 2021
Source: https://www.dax-indices.com/document/Resources/Guides/Historical_Index_Compositions_20.12.2021.pdf

OUTLIER DETECTION

Daily Returns and Volume of the DAX

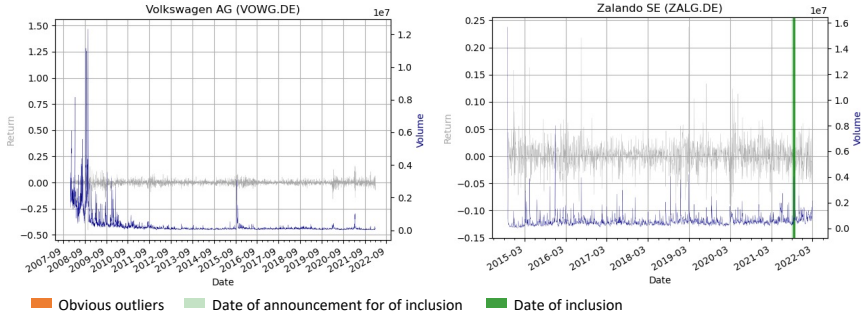


We analysed the data in regard to outliers both visually & analytically[1]. In the visualization of the DAX, we could not detect any *unexplainable* outliers. For example:

- Volume with stronger movement around 2008 and 2012 due to the Financial and Euro crisis
- COVID-19 impact can be observed

DAX Returns	
Observations	3592
Highest daily loss	12.24%
Highest daily gain	11.40%
Daily avg. return	0.02%
Std. deviation	1.41

Daily Returns and Volume of Siemens AG and Zalando SE



Exemplary view on Volkswagen and Zalando:

- Volkswagen with a spike in volume around the short squeeze in 2008
- Available data for Zalando only started in 2015. Not a problem as the DAX inclusion happened in 2021 (green line)

[1]Considering seasonality effects and the trend of the stock, we determined whether the change in return and volume differed unexplainably strong from the previous day

SHORT TERM EFFECTS

SHORT TERM EFFECTS: VOLUME

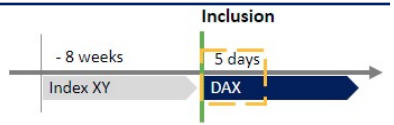
Methodology

- The Mean Volume Ratio is a market adjusted ratio between the volume traded in a time period after an event and the mean volume traded in the 8 weeks before said event.

1) $MVR_t = \frac{1}{N}\sum_i VR_{it}$ 2) $VR_{it} = \frac{V_{it}}{V_{mt}} * \frac{V_m}{V_i}$

Inclusion Day

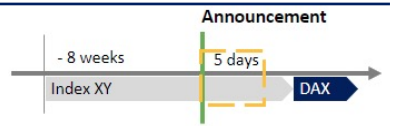
- **Hypothesis:**
  Volume increases after being included into an index due to, among others, public and private index funds.



		Day 1		Day 1-5	
	N	mvr	σ	mvr	σ
Included	22	1.47	1.80	1.11	0.92
Included 40	10	0.87	0.16	0.88	0.23
Included Rest[1]	12	1.98	2.35	1.31	1.20
Excluded	10	0.88	0.47	0.76	0.34

Announcement Day

- **Hypothesis:**
  Compared to the inclusion day effects should be less severe as most investors are already aware of the inclusion and fund effects do not apply yet.



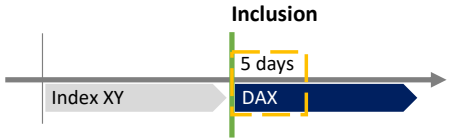
		Day 1		Day 1-5	
	N	mvr	σ	mvr	σ
Included	22	1.64	0.88	1.32	1.10
Included 40	10	1.79	1.22	1.22	0.76
Included Rest[1]	12	1.53	0.48	1.40	1.32
Excluded	10	1.47	1.37	1.35	1.30

[1] All inclusions beside the DAX30 to 40 revision

SHORT TERM EFFECTS: RETURNS

Hypothesis: Due to the increase in volume (demand) the prices/returns should also increase.

Inclusion Day

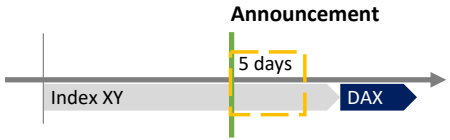


Results

- Looks like prices tend to rise on the first day after inclusion and then drop
- All T-tests failed to reject H0

		Day 1		*Day 1-5*	
	N	**μ (%)**	**σ**	**μ (%)**	**σ**
Included	22	0.81	2.23	-0.25	2.07
Included 40	10	1.20	1.84	-0.25	2.27
Included Rest[1]	12	0.48	2.54	-0.24	1.91
Excluded	10	-1.24	2.46	-1.70	5.35

Announcement Day



Results

- The output indicates no direct effect on returns
- All T-tests failed to reject H0

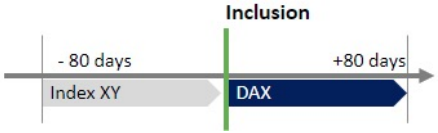
		Day 1		*Day 1-5*	
	N	**μ (%)**	**σ**	**μ (%)**	**σ**
Included	22	0.15	2.43	-0.03	1.92
Included 40	10	0.90	2.70	0.08	1.62
Included Rest[1]	12	-1.36	1.57	-0.12	2.14
Excluded	10	-0.68	4.53	-0.53	4.02

[1] All inclusions beside the DAX30 to 40 revision

SHORT TERM EFFECTS: VOLATILITY

Hypothesis: Increasing trading volumes generally result in higher return volatility. Hence, for both events we would expect to observe an increase in return volatility.

Inclusion Day



Results[2]

- No increase in volatility
- Return volatility is not influenced by the inclusion

		5 Days		*80 Days*	
	N	**μ**	**σ**	**μ**	**σ**
Included	22	0.000	0.009	0.001	0.006
Included 40	10	-0.001	0.008	0.005	0.004
Included Rest[1]	12	0.001	0.010	-0.002	0.005
Excluded	10	0.005	0.014	-0.017	0.049

Announcement Day

Results[2]

- No increase in volatility either
- Return volatility is not influenced by the announcement

		5 Days		*80 Days*	
	N	**μ**	**σ**	**μ**	**σ**
Included	22	0.000	0.011	0.002	0.006
Included 40	10	-0.001	0.006	0.005	0.004
Included Rest[1]	12	0.000	0.013	-0.002	0.005
Excluded	10	0.005	0.023	-0.016	0.049

[1] All inclusions beside the DAX30 to 40 revision

[2] The values below are the means and standard deviations of the differences between return standard deviations over a specific timeframe before and after an event.

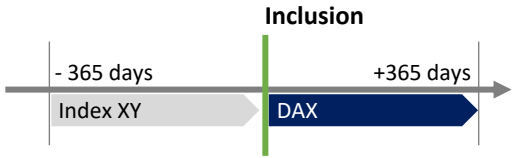
MARKET CORRELATION

MARKET CORRELATION: DAY OF INCLUSION/EXCLUSION

Hypothesis: Included companies start to correlate stronger with the market once they are included in the index.

Methodology

- Correlation effect 1 year before and 1 year after inclusion/exclusion
- Pearson correlation of the returns between the DAX and the stock
- Multicollinearity is by definition “a problem”



Results

- Results for *Included Rest* really unintuitive to be negative
- Monthly view: no real change in correlation visible/detectable
- DAX30 to DAX40 revision appears to be exceptional due to higher mass of included companies
- Exclusion seems to have no big impact on the correlation
- No significance whatsoever: small sample size

	1 year		*1 quarter*		*1 month*	
	Avg. Δ	**p_Value**	**Avg. Δ**	**p_Value**	**Avg. Δ**	**p_Value**
Included	0.06	0.387	0.04	0.553	0.01	0.903
Included 40	0.20	0.094	0.16	0.140	0.06	0.636
Included Rest[1]	- 0.05	0.467	- 0.06	0.399	- 0.03	0.681
Excluded	0.01	0.910	0.00	0.979	- 0.06	0.610

Impact Inclusion Day

[1] All inclusions beside the DAX30 to 40 revision

MARKET CORRELATION: DAY OF ANNOUNCEMENT

Hypothesis: Announcements are often an “open” secret thus no big effect can be observed with this date.

Methodology

- Correlation effect 1 year before and 1 year after announcement
- Pearson correlation of the returns between the DAX and the stock
- Multicollinearity is by definition “a problem”

Results

- Yearly view now highly unsignificant: this shows the problematic size of the sample (compare *Included 40* to previous one)
- Quarterly view produces the most significant results
- Possible explanation: Announcement reduces uncertainty in stocks
- DAX30 to DAX40 revision still appears to produce a bigger delta in correlation
- Exclusions still don’t show any effect or tendency

	1 year		*1 quarter*		*1 month*	
	Avg. Δ	**p_Value**	**Avg. Δ**	**p_Value**	**Avg. Δ**	**p_Value**
Included	- 0.05	0.545	0.16	0.042	- 0.05	0.555
Included 40	0.02	0.849	0.25	0.059	0.02	0.909
Included Rest[1]	- 0.11	0.184	0.09	0.352	- 0.10	0.265
Excluded	- 0.10	0.423	0.03	0.798	- 0.10	0.512

Impact Announcement Day

[1] All inclusions beside the DAX30 to 40 revision

SYSTEMATIC RISK

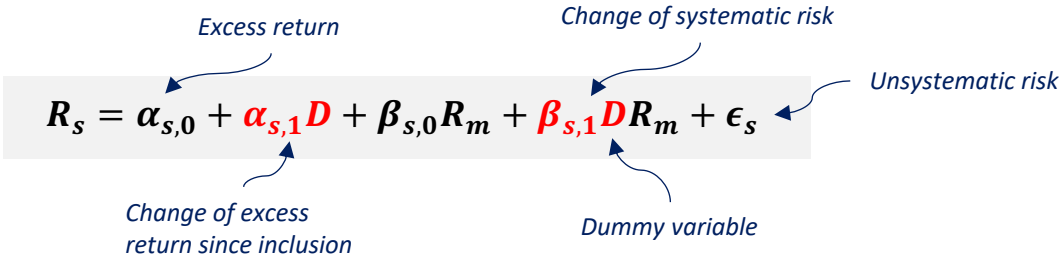
SYSTEMATIC RISK: METHODOLOGY

Hypothesis: Stocks that get included into an index see their systematic risk increase. Vice versa the systematic risk for excluded stocks decreases.

Methodology

- Again, we look at the inclusion/exclusion date, as well as the announcement date
- Regression[1] horizon is ±1 period around the event
- We looked at 2 different periods: 1 year & 1 quarter. 1 month is too short for a regression as the sample size would be too small
- **MSCI Germany** as a good benchmark, representing over 85% of the German market. Investors point of view

Hypothesis function:



Ralf Hermann

The empirical study from 1997 analysed the **systematic risk component** of stocks introduced to the DAX.

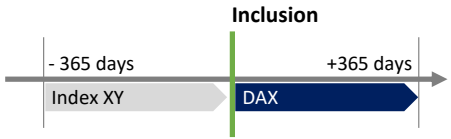
Their key findings were:

- Significant increase in the systematic risk of the individual stocks and the portfolio
- This increase is even stronger for stocks with a high index weight

[1] OLS in conjunction with a correction procedure for serially correlated error terms. (Newey/West)

SYSTEMATIC RISK: GENERAL RESULTS

Inclusion Day



- Overall systematic risk (beta) **increases by 0.13**
- **5** out of **22** DAX stocks show a **significant** (<5%) increase in their systematic risk (**3** out of **10** shows a significant decrease)

	1 year		*1 quarter*	
	Avg.	**R^2**	**Avg.**	**R^2**
Included	**0.13**	**0.261**	**0.08**	**0.312**
Covestro AG	0.55	0.351	0.45	0.232
MTU Aero Engines AG	0.43	0.427	0.06	0.902
...	...	...	...	...
Zalando SE	0.27	0.423	0.53	0.317
Excluded	**-0.02**	**0.281**	**-0,10**	**0,314**

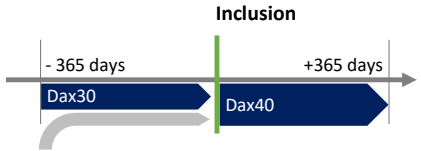
Announcement Day

- Overall systematic risk (beta) **increases by 0.11**
- **4** out of **22** DAX stocks show a **significant** (<5%) increase in their systematic risk (**1** out of **10** shows a significant decrease)

	1 year		*1 quarter*	
	Avg.	**R^2**	**Avg.**	**R^2**
Included	0,11	0,264	-0,23	0,325
Covestro AG	0.51	0.351	-0.66	0.582
MTU Aero Engines AG	0.42	0.425	-0.21	0.271
...	...	...	...	...
Zalando SE	0.20	0.529	-1.13	0.202
Excluded	0,02	0,278	-0,06	0,322

SYSTEMATIC RISK: DAX30 TO DAX40 REVISION

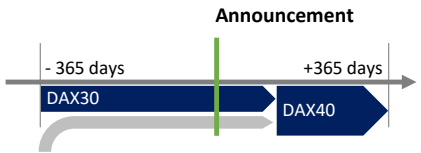
Inclusion Day



- Overall systematic risk (beta) **increases by 0.23**
- **4** out of **10** DAX stocks show **significant** (<5%) increase in their systematic risk
- Index weight has no impact on the beta change

	1 year		*1 quarter*	
	Avg.	**R^2**	**Avg.**	**R^2**
Included	**0.13**	**0.261**	**0.08**	**0.312**
Included 40	**0.23**	**0.199**	**0.00**	**0.267**
1-5 by weight	0.24	0.321	-0.08	0.388
6-10 by weight	0.22	0.079	0.09	0.146
Included Rest[1]	**0.05**	**0.313**	**0.00**	**0.337**
Excluded	**-0.02**	**0.281**	**-0.10**	**0.314**

Announcement Day



- Overall systematic risk (beta) **increases by 0.19**
- **None** of the **10** DAX stocks show **significant** (<5%) increase in their systematic risk
- Index weight has no impact on the beta change

	1 year		*1 quarter*	
	Avg.	**R^2**	**Avg.**	**R^2**
Included	**0.11**	**0.264**	**-0.22**	**0.352**
Included 40	**0.19**	**0.199**	**-0.31**	**0.246**
1-5 by weight	0.22	0.316	-0.08	0.388
6-10 by weight	0.17	0.082	-0.57	0.129
Included Rest[1]	**0.04**	**0.318**	**-0.02**	**0.358**
Excluded	**0.02**	**0.278**	**-0.06**	**0.322**

[1] All inclusions beside the DAX30 to 40 revision

CONCLUSION

CONCLUSION

SHORT TERM EFFECTS
The traded volume notably increases after the analysed events. Contrary to previous papers, we could not observe the same price pressure effects.

MARKET CORRELATION
We were able to observe some intuitive tendencies. Still the limitations due to the small sample size denied a deeper understanding of the underlying effect.

SYSTEMATIC RISK
There is a notable increase in systematic risk after the inclusion in the index. However only a fraction of the stocks showed significant results.

Overall, we were able to confirm some findings from previous papers regarding the S&P 500. However, as only a small number of index revisions occurred in the DAX, the predictive power is limited. Thus, further research is necessary to make reliable conclusions.

Further research possibilities
- Analyse if the reversal effects, observed in previous papers, also exist in the DAX
- Include a longer time period (>20 years) and thus higher sample size
- Consider another European index, with a bigger market, e.g., EURO STOXX 600

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Applied Data Science (Intake 2021)

GitHub Repository:

https://github.com/LarsWrede/GSFM