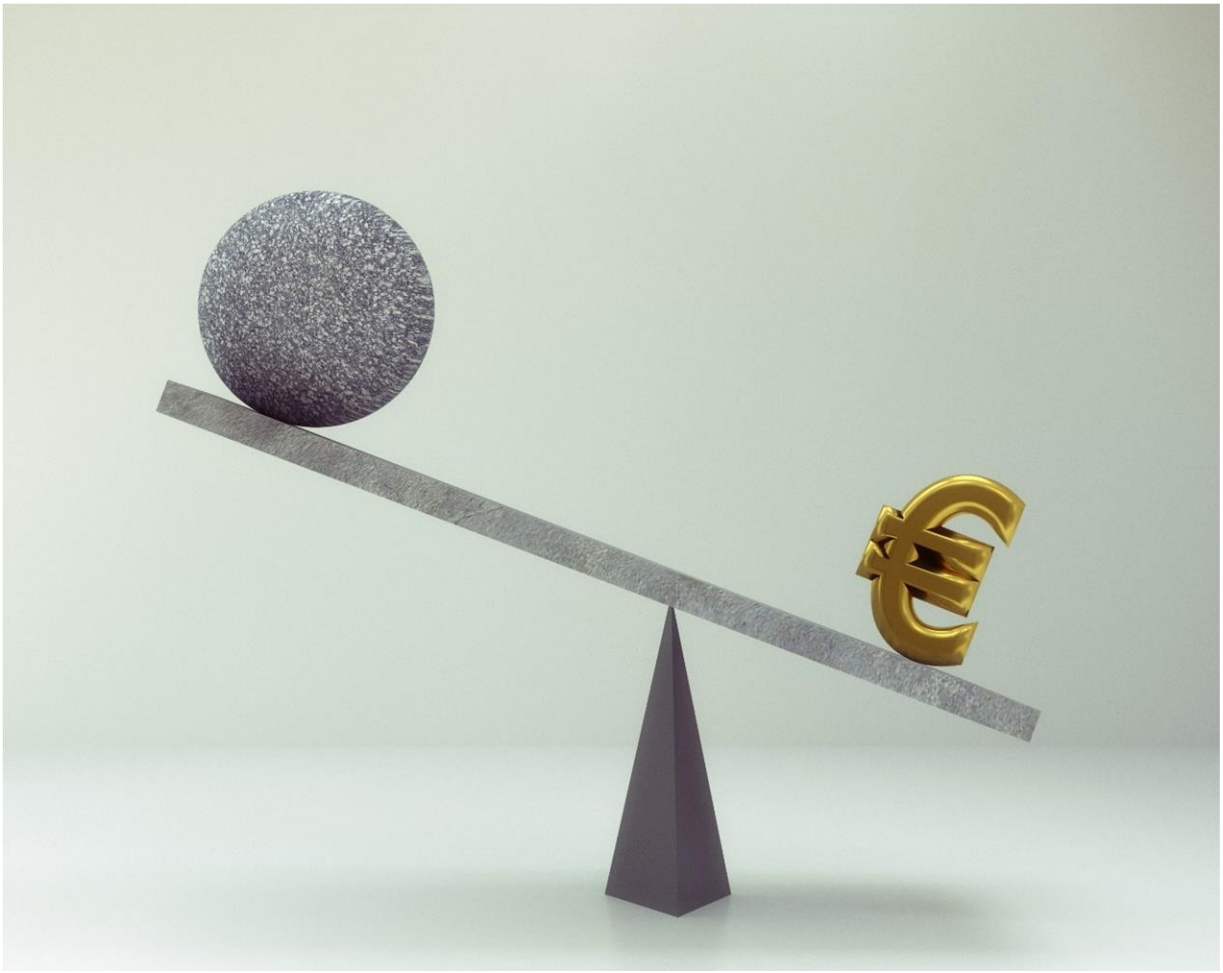
(The Hidden)

Index Turnover Costs

The Visible Price of Transparency



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EXECUTIVE SUMMARY

- Index arbitrageurs anticipate index adjustments beforehand and take opposite positions, thus bidding up (down) the prices of additions (deletions). Consequently, at rebalancing, the index tracking investors pay (receive) higher (lower) prices for the additions (deletions). These are implicit costs associated with index turnover: The "index turnover costs".
- Using a Eurozone blue chip index, we quantify the turnover costs for nine ordinary rebalancing days considering different lookback periods of 5, 10, 20 and 40 days prior to these rebalancing days. We find average turnover costs ranging from 12 to 36 basis points.
- Running a statistical bootstrap, we simulate 10,000 turnover costs. Given these simulations, we observe that the turnover costs are significantly larger than zero.
- We further decompose the turnover costs using the Fama & French five-factor model. Our results indicate that the excess returns of the additions and deletions are partially explained by their factor exposure, thus implying that the turnover costs are significantly larger than zero (between 9 to 32 basis points and in line with the results of the second point).
- We conclude that index turnover costs can be reduced by 1) having multiple players in the indexing business, 2) reducing the index turnover by adding turnover constraints into the index creation's methodology and 3) implementing a transparent rebalancing procedure with a long buffer time before the rebalancing date.

INTRODUCTION

The intrinsic value of a stock or price, in the fundamental sense, is calculated as the present value of the discounted future cashflows expected to be generated. The noise around this price, as a direct effect of the supply and demand of a stock, is therefore irrelevant as the stock is expected to trade at its intrinsic value in the long term (according to the efficient markets theory). Additionally, the noise, entitled idiosyncratic risk in the CAPM theory, is irrelevant for an investor holding a large portfolio of various stocks thanks to the diversification effect. In the long run, an investor, in a portfolio context, only cares about systematic risk and ignores random idiosyncratic fluctuations, as long as they are random.

However, we might encounter scenarios in which these seemingly random fluctuations exhibit a systematic pattern. An index composition is adjusted by buying and selling stocks when certain components are added or removed from a certain index at the specific rebalancing days. This adjustment allows index arbitrageurs to anticipate changes beforehand and take opposite positions as the index composition is generally rule based: they buy the additions and sell the deletions prior to the rebalancing. By doing so, they create a supply and demand shock. They bid up (down) the prices of the addition (deletions) causing additions (deletions) to have positive (negative) index excess returns. Consequently, at rebalancing, the index tracking investor pays higher prices for the additions and receives lower payments for the deletions. This leaves the investor at an implicit cost associated with index turnover. We label these "index turnover costs". Petajisto (2010) investigates these turnover costs for the S&P 500 and the Russell 2000 index. He finds the index turnover costs to be 21-28 basis point p.a. for the S&P 500 and 38-77 basis points p.a. for the Russell 2000. The effects of the supply and demand shock for Russell indices are also found by Cariño and Pritamani (2007), Chen, Noronha, and Singal (2006) and Madhavan (2003).

In this study, we evaluate the existence of turnover costs and quantify them using a Eurozone blue chip index as a starting universe. Employing an index neutral strategy, we calculate the turnover costs

for nine ordinary rebalancing days between 2007 and 2016. We assess their statistical significance by applying a bootstrap method. Furthermore, we expand our analysis using index excess returns adjusted for style effects that may drive the performance of the additions and deletions. We conclude with a discussion on how turnover costs can be decreased and which steps are needed to do so.

ASSESSING THE COSTS

In this study we evaluate the existence of turnover costs and quantify them using as a starting universe a Eurozone blue chip index (henceforth referred to as *the index*), which is rebalanced annually in September. Our sample covers nine ordinary rebalancing cycles from 2007 to 2016. In 2012, there was no change to the index composition. Each rebalancing cycle is divided into four periods ranging from 5, 10, 20 and 40 days prior to each rebalancing. The 20 days lookback period hereby reflects the time between the official announcement and the rebalancing day. We measure the turnover costs of the index using an index neutral strategy, in which we evaluate the impact that trading additions and deletions prior to the official index rebalancing has on the performance of the added and deleted instruments, and consequently on the index's performance itself:

First, we build market capitalization weighted portfolios of the additions and deletions at every rebalancing. Afterwards, the excess returns of those portfolios against the index are calculated and cumulatively summed up to the respective rebalancing day for different lookback periods. The resulting cumulative excess returns are later used to compute the turnover costs as described in Formula 1. Table 1 contains those cumulative excess returns. A graphical representation of the entire time series can be found in Appendix A. Our findings support the hypothesis that additions outperform the index before they are added and deletions underperform the index before they are deleted from it. The magnitude and persistence of the out- and underperformance indicates the existence of the shock to the supply and demand for index additions and deletions. In order to evaluate the impact of

Table 1 *Cumulative excess returns of the additions and deletions portfolios against the index*

	ADDITIONS PORTFOLIO				DELETIONS PORTFOLIO			
Year	**5 days**	**10 days**	**20 days**	**40 days**	**5 days**	**10 days**	**20 days**	**40 days**
2007	6,7%	5,9%	4,7%	5,5%	-1,0%	-5,3%	-7,4%	-7,0%
2008	3,0%	3,8%	3,9%	-3,4%	-21,2%	-20,5%	-25,8%	-22,7%
2009	2,6%	7,8%	6,0%	5,8%	-2,9%	-5,4%	-12,3%	2,2%
2010	5,7%	9,2%	10,8%	13,3%	1,0%	0,6%	-1,2%	-3,3%
2011	0,1%	5,8%	12,3%	12,7%	-3,4%	-13,9%	-13,2%	-25,5%
2013	1,1%	0,6%	3,9%	6,2%	-3,2%	-4,6%	-0,8%	-2,0%
2014	0,1%	3,3%	4,5%	8,3%	0,4%	0,1%	3,2%	-1,3%
2015	2,9%	4,3%	7,7%	20,1%	-6,4%	-11,3%	-20,0%	-33,4%
2016	2,7%	0,8%	-2,3%	3,7%	-2,5%	-1,8%	1,4%	-3,3%
Mean	**2,8%**	**4,6%**	**5,7%**	**8,0%**	**-4,4%**	**-6,9%**	**-8,5%**	**-10,7%**

Table 2 *Turnover costs. Numbers are in basis points.*

Year	5 days	10 days	20 days	40 days
2007	37.13***	51.25***	51.22**	58.00*
2008	11.80***	12.15*	15.07**	6.81
2009	11.58	31.73***	32.83*	17.43
2010	8.77***	14.47***	17.85***	22.71**
2011	7.75	51.38*	85.31**	86.37*
2013	3.93	4.62	5.48	9.47
2014	-0.13	3.19	2.74	8.85
2015	13.19**	21.55**	40.12***	89.83***
2016	13.86	6.85	-9.92	20.05
Mean	**11.99**	**21.91**	**26.74**	**35.50**

Statistical Significance at 1%, 5 %, and 10% are marked respectively by ***, **, * (method in the next section: **Bootstrapping**)

this phenomenon on the index level, we calculate scaling weights. For the additions, these are calculated using the market capitalizations of the additions and dividing them by the market capitalization of the index on the rebalancing days. The weights of the deletions are determined in a similar fashion using the days at the beginning of the respective periods. Using these weights, we quantify the turnover costs by calculating the value of the spread between the portfolios and the index according to Formula 1:

Formula 1 *Calculation turnover costs*

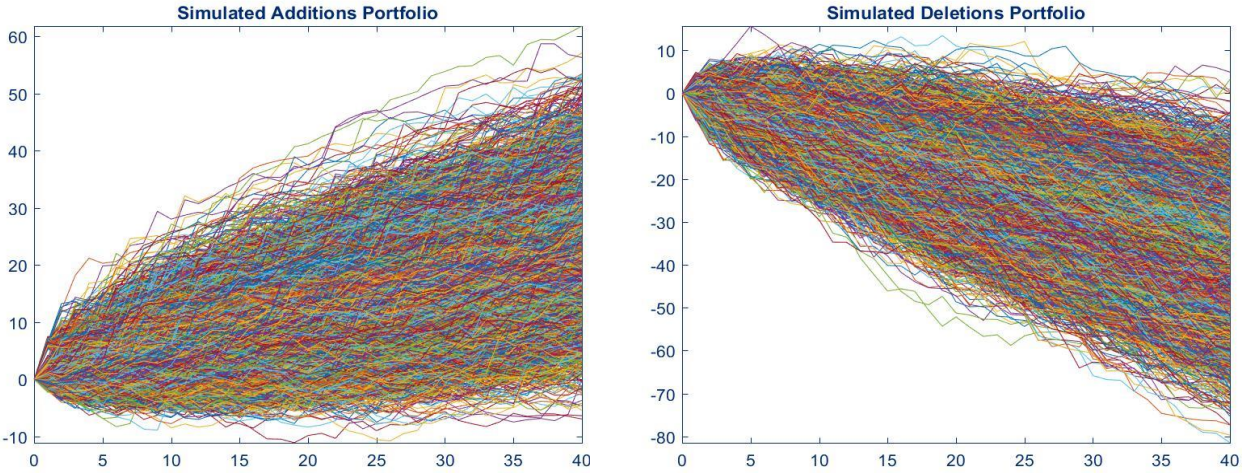
$$TC_t = \sum_{i=1}^{N_t^A} \left(w_{i,t}^A * CER_{i,t}^A \right) - \sum_{j=1}^{N_t^D} \left(w_{j,t}^D * CER_{j,t}^D \right)$$

where TC_t are the turnover costs at rebalancing t, N_t^A is the number of additions, $w_{i,t}^A$ is the scaled weight and $CER_{i,t}^A$ is the cumulative excess return of addition i, $N_t^D$is the number of deletions, $w_{j,t}^D$ is the scaled weight and $CER_{j,t}^D$ is the cumulative excess return of deletion j.

Table 2 shows the realized turnover costs for every rebalancing day using the four lookback periods respectively. As it can be inferred from Table 1, the turnover costs of the index are positive at all but two rebalancing days. We can observe that the average turnover costs are the highest for the 40 days lookback period with 35.50 basis points. The shortest considered lookback period exhibits considerably smaller average turnover costs of 12 basis points. As Table 1 and Figure 1 indicate, this is due to the fact that the additions (deletions) have already outperformed (underperformed) the index well before the actual rebalancing. This supports the hypothesis that index arbitrageurs forecast upcoming component changes and trade before the rebalancing and even before the official announcement.

BOOTSTRAPPING

Figure 1 *Simulations of cumulative excess returns. The studied year is 2015 considering a 40 days lookback period. The x-axis shows the daily lookback period. The y-axis illustrates the cumulative excess returns in percentages points.*



As we see in Table 2, the turnover costs calculated are mostly larger than zero. Yet, given only the figures in Table 2, it is hard to evaluate whether there is a systematic rationale or whether the observable turnover costs are just coincidental. After all, there are a few instances in which the numbers are close or even slightly below zero. In order to assess the statistical significance of the observed turnover costs, we run a statistical bootstrapping procedure. We run 10,000 simulations for every rebalancing and lookback period. First, we simulate the additions and deletions portfolio's cumulative excess returns as shown in Figure 1. Based on these simulations, we perform the calculations as shown in Formula 1. Consequently, we receive 10,000 simulated turnover costs for every rebalancing and lookback period as illustrated in Appendix C. Using these simulations, we compute the probability that the turnover costs observed at every rebalancing and for each lookback period are smaller than zero. This is done by dividing the number of simulated turnover costs that fall below zero by the overall number of simulations. Table 2 contains, by the means of the asterisks, the output of these simulations. We can observe that the respective turnover costs, which are larger than zero, are statistically significant.

REDEFINING EXCESS RETURNS

Having computed the turnover costs and established their statistical significance, there is yet to determine how we define the excess return used to compute the costs. After all, the excess returns against the index realized by the additions and deletions may also be due to style effects originating from their exposure to risk factors, as described by the five-factor model (FF5) of Fama and French (2015). We therefore redefine the index excess returns by taking into account four risk drivers known to

Table 3 *Turnover costs using cumulative excess returns calculated applying the risk drivers in the FF5. Numbers are in basis points.*

Year	5 days	10 days	20 days	40 days
2007	28.70***	50.84***	52.48***	74.13**
2008	8.29**	7.17	16.84**	8.97
2009	14.11***	35.59***	37.45**	53.34**
2010	7.95***	12.39***	15.08***	19.24**
2011	13.05	27.95	38.72	27.39
2013	4.32	6.78	8.88	15.72
2014	-0.51	2.32	0.76	5.76
2015	4.12	10.40*	24.03**	61.25***
2016	2.71	-6.51	-4.19	24.58
Mean	**9.19**	**16.33**	**21.11**	**32.26**

*** Significant at 1%, ** Significant at 5 %, * Significant at 10%

explain stock returns. For this purpose, we run time series regressions using six months of daily data preceding each rebalancing event. Using the daily factors from Kenneth French's website[1] covering the European stock market, we decompose the excess returns of the additions and deletions against the index by estimating the factor loadings associated with value, size, profitability and investment. We then recalculate the cumulative excess return needed in Formula 1 by additionally subtracting the risk premia from the index excess returns. Table 3 shows the turnover costs adjusted for the FF5 factors. We can observe that, on average, the turnover costs are slightly smaller than the figures displayed in Table 2. This indicates that the abnormal returns we see in Table 1 can partly be explained by the factor exposure of the additions and deletions. Nonetheless, the turnover costs in Table 3 are, on average, still considerably larger than zero. We can further see that there is statistical significance for a large number of the computed turnover costs, indicating that there is a systematical cause associated with the price changes of the additions and deletions before the rebalancing that cannot be explained by well-known risk drivers.

MINIMIZING THE COSTS FOR INVESTORS

We show that there are implicit costs associated with index adjustments that can make investments into indices costlier than an investor might anticipate beforehand. Yet, is this the end of the passive asset management

1 http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

industry? We argue that the answer is no. There are three main courses of actions that can help to significantly reduce the price impact of index adjustments: First, having a competitive market of index providers is advantageous, as this ensures the existence of multiple similar indices – in the same region - exhibiting different rebalancing cycles. Thus, the assets tied to the markets can be distributed among the different indices. The result is a decrease in the amount that index tracking investors need to trade at any given rebalancing day. Second, the index turnover itself could be minimized by adding turnover constraints to the index methodologies. Such constraints may be implemented using rank buffers or weight constraints. Finally, we argue for transparency around index rebalancing. A transparent rebalancing procedure with a clear announcement well before rebalancing can help expand the time when the index arbitrageurs make their trades, and consequently dilute the impact on the prices of the additions and deletions. Taking into account these three considerations, we believe that the implicit costs that investors face when investing into index tracking products can be significantly reduced, if not eliminated.

CONCLUSION

The arithmetic of passive investing dictates that investors buy and sell stocks because they are added or removed from a certain index. As index arbitrageurs anticipate those trades, they buy the additions and sell the deletions prior to the index rebalancing. Depending on the volume of the trades and the company's respective size, the index arbitrageurs thus bid up (down) the prices of the additions (deletions) causing additions (deletions) to have positive (negative) index excess returns. Consequently, at rebalancing, the index tracking investors pay higher prices for the additions and receive lower payments for the stocks that they need to sell due to their deletion from the tracked index. This causes a drag of the index performance associated with the index turnover. We denote these as "turnover costs".

Using a Eurozone blue chip index that is rebalanced annually in September, we quantify the turnover costs. Our sample covers nine ordinary index adjustments and four different lookback periods of 5, 10, 20 and 40 days prior to these rebalancing dates. We find average turnover costs ranging from 12 to 36 basis points. Statistical bootstrapping helps us to assess the significance of these results. We run 10,000 simulations and find that the observable turnover costs are significantly larger than zero considering many rebalancing days and lookback periods. Yet, the index excess returns used to determine the turnover costs might still be explained by commonly known risk drivers. Therefore, we recalculate the turnover costs using excess returns adjusted for value, size, profitability and investment factors. We find that even though the factors partly explain the price changes of the additions and deletions, there are still considerable turnover costs observable that are statistically larger than zero. On average, these costs range from 9 to 32 basis points. However, we are confident that these can be drastically reduced. First, we see this as a support for a multi-indices business as the volume traded can be split between different indices that rebalance at different days, thus decreasing the price impact that every trade has. Second, the turnover of these indices itself can be decreased by implementing turnover constraints. Finally, transparent rebalancing procedures with a clear announcement well before re-balancing can help expanding the time when the index arbitrageurs make their trades, further decreasing the index turnover costs.

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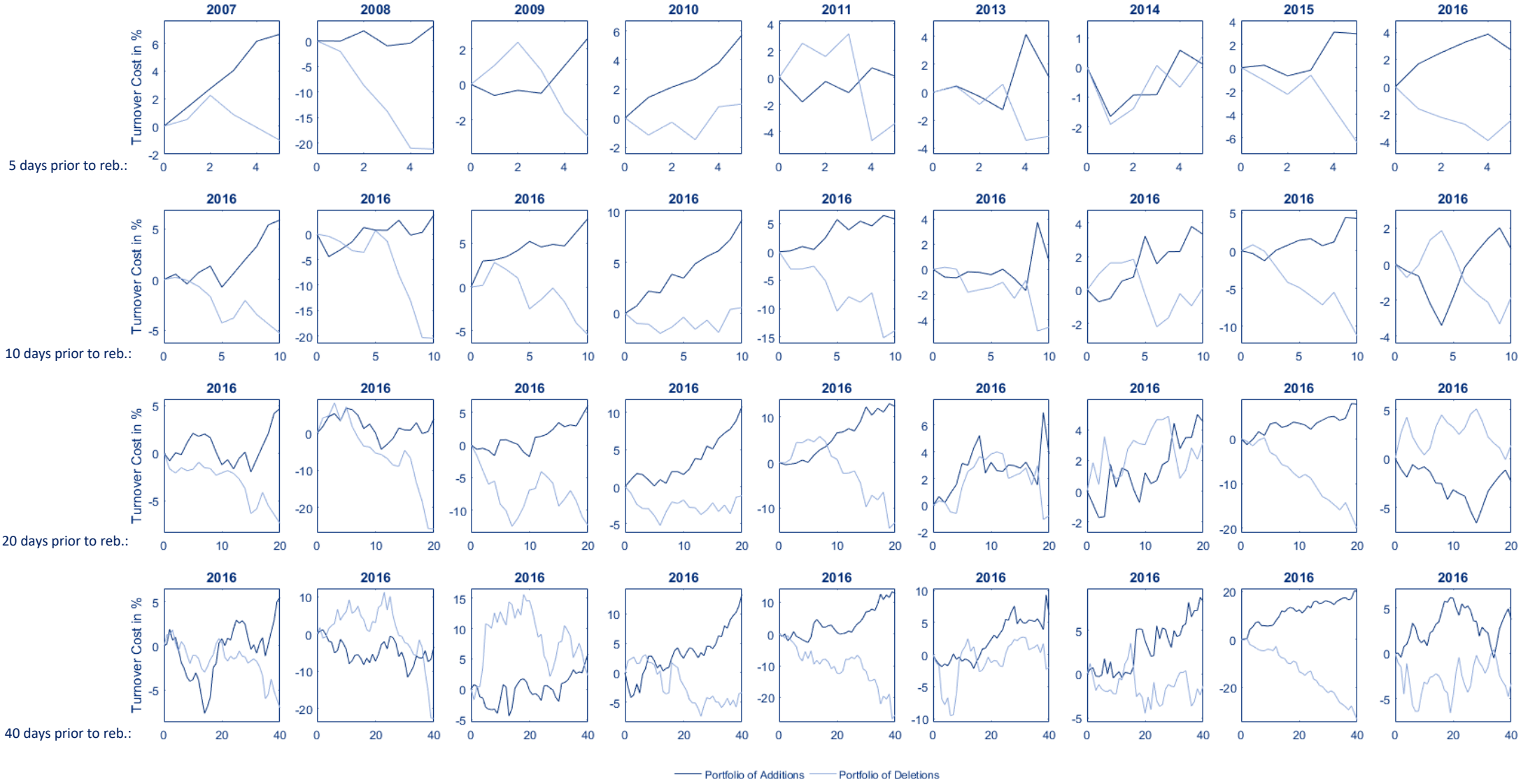
APPENDIX A: CUMULATIVE EXCESS RETURNS OF THE ADDITIONS AND DELETIONS PORTFOLIOS

Appendix A *shows the cumulative turnover costs of the additions and deletions portfolios in % points for all studied years and considered lookback periods.*

Each row shows the evolution of the turnover costs in % points for the selected rebalancing days respectively from 2007 till 2016.

Each column illustrates the turnover costs in % points for the same rebalancing respectively for the last 5, 10, 20 and 40 days prior to rebalancing day.

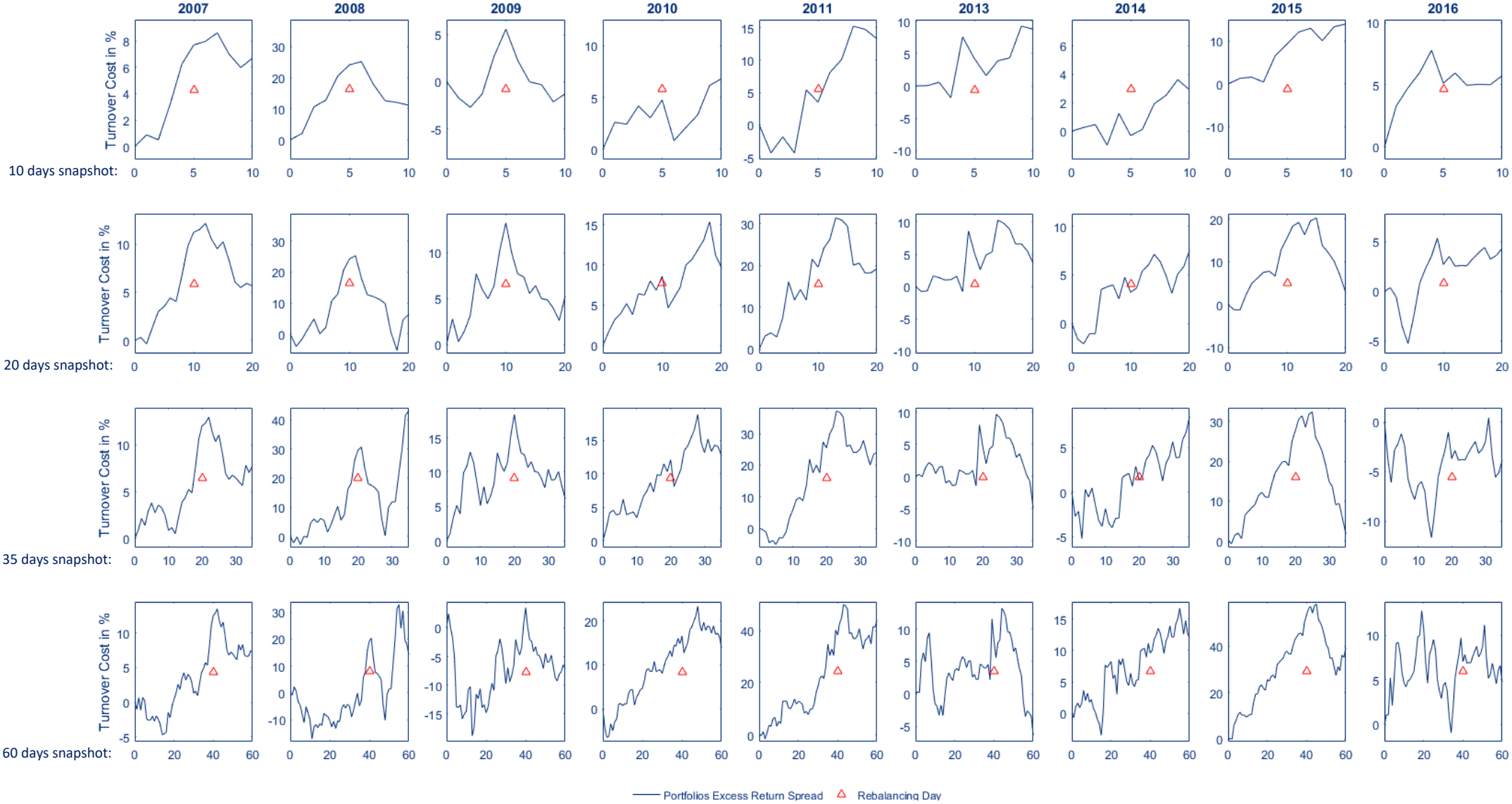


APPENDIX B: CUMULATIVE EXCESS RETURNS SPREADS OF THE ADDITIONS AND DELETIONS PORTFOLIOS

Appendix B *shows the cumulative turnover costs spread between the additions and deletions portfolios in % points for all studied years and considered lookback periods.*

Each row shows the evolution of the turnover costs spread in % points for the selected rebalancing days respectively from 2007 till 2016.

Each column illustrates the turnover costs spread in % points for the same rebalancing respectively for the last 5, 10, 20 and 40 days prior to rebalancing day. The rebalancing days are in red.

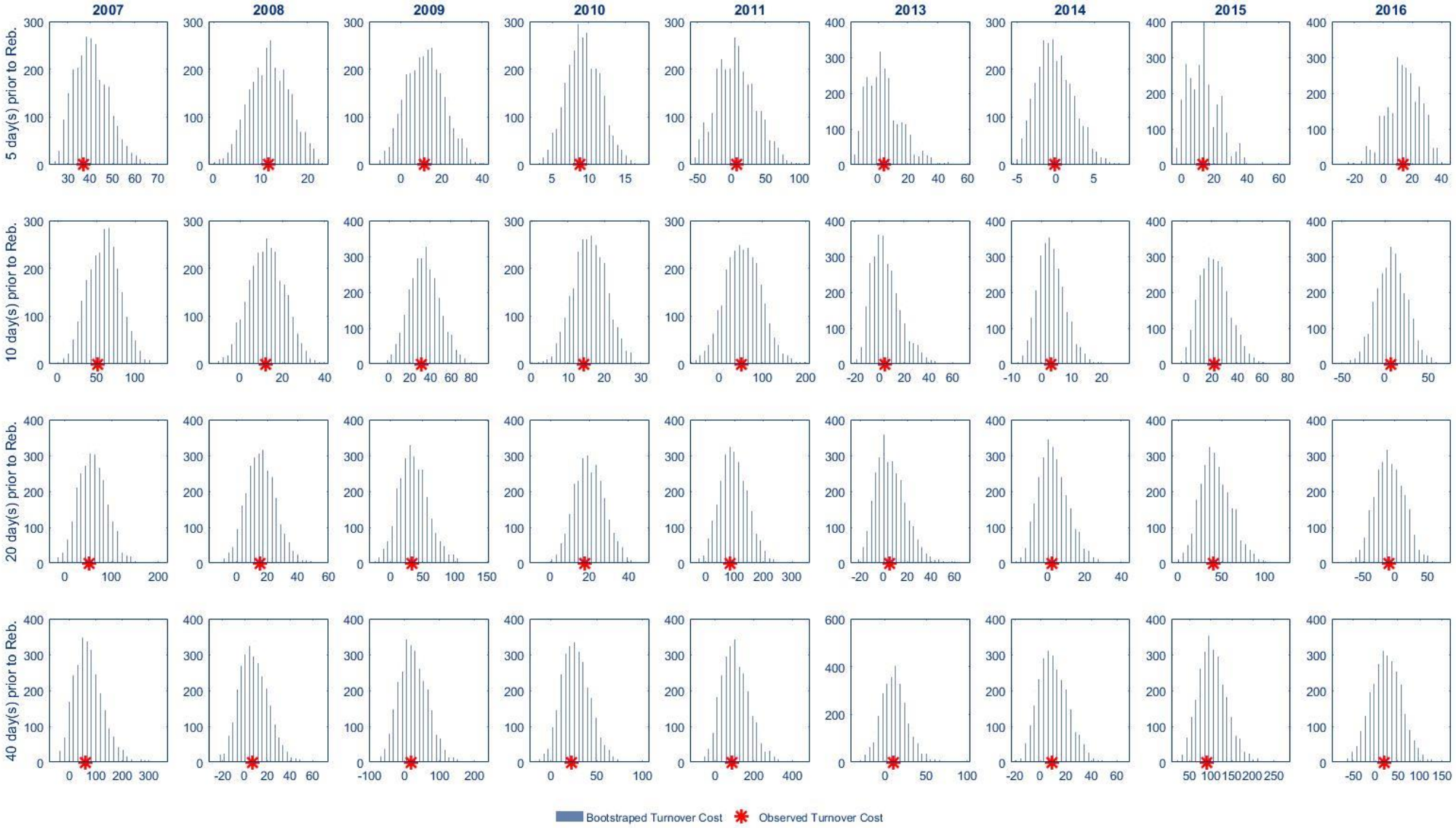


APPENDIX C: BOOTSTRAPPED TURNOVER COSTS

Appendix C *Bootstrapped versus observed turnover costs for the various lookback periods (each lookback period corresponds to a row below) and various rebalancing days (each rebalancing day is a column below)*

The x-axis shows the turnover costs in basis points.

The y-axis illustrates the numbers of simulations falling into the x-axis ranges.



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