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DILUTION OF SECTOR EXPOSURES: WHEN DOES UNINTENDED INDEXING HAPPEN?

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We analyze how the inclusion of several sectors in a portfolio leads to a countering of exposures and to a replication of the index. Using a weight-based measure, we find that on a composition level unintended indexing appears to happen with only moderate severity. However, co-movement with the broad index as measured with standard techniques is a result that is found at already small numbers of included sectors. The results found are robust over time and market phases. We show that investors to sector exchange-traded funds should carefully select the number of investments and base this on the resulting exposure rather than on portfolio-weighting observations. Otherwise, their sector bets or selections are diluted by unintended indexing.

1 Introduction

Exchange-traded funds (ETFs) are now an established part of the asset management industry, and there is a need for research on the effects of mixing ETFs and therefore exposures of portfolios. While ETFs may be included in various types of portfolios, the efficient use of ETFs to efficiently gain exposure to particular asset classes, branches, industries, and/or countries are especially appealing in the context of cost-consciousness and when building large (multi-asset class) portfolios. Reduced necessities regarding monitoring compared with investments in actively managed portfolios and less cost are among the most striking arguments in favor of ETFs.

Driven by the aim of generating alpha by using beta products, increased attention in the asset management industry toward multi-asset class investments and therefore the need for transparent, clear-cut, and liquid target investments has

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increased the use of ETF-based solutions. This makes the topic relevant not only to researchers seeking to gain insight into important effects when building portfolios, but also for portfolio managers and asset allocators as well. Especially nowadays with institutional money flowing increasingly into ETFs and with the emergence of beta-play in multi-asset portfolios, our study contributes to the needed analyses that should be carried out when making allocations to ETFs.

Naturally, investors and asset managers need to take care of the compositions of their investments, and this is not limited to actively managed products. As ETFs provide access to potentially large baskets of assets with observable weightings, investors to ETFs do not face the problems associated with lacks of transparency that may arise when investing in actively managed funds.

While this removes the problem of transparency, the problem of having multiple exposures to the very same asset or factor remains—especially when it comes to multi-asset allocations and sector- or asset-class rotations with numerous assets. We show that this problem and its effect on portfolio co-movement with the market may be underestimated when focusing on the compositions of included ETFs only and may lead to inefficient compositions.

We examine how an increasing sum of sectors results in approaching the designated benchmark that the investor seeks to outperform by making sector bets—and how quick this may be the case. Analyzing both the compositions and exposures of the resulting portfolios built from stock-market sector ETFs, our study is related to discussions regarding fund portfolio or fund-of-fund (FoF) construction. Special problems of equity FoFs are averaging out of exposures and dilution effects caused by holding multiple equity mutual funds. However, this is not limited to portfolios built out of actively managed equity mutual funds, but may arise for equity ETF portfolios as well. In particular, the number of different funds to be included is crucial with respect to diversification and the strength of indirect exposures resulting from the weightings in a portfolio.

Accordingly, when building portfolios including funds, a major challenge faced by managers is the selection of not only which funds or what kinds of funds to include in the portfolio, but also how many funds to include. This challenge arises because there appears to be a trade-off between diversifying the portfolio and averaging or counter-investing. Effects of averaging out of characteristics or counter-investing may be present when diversifying holdings over too many target funds, thereby involuntarily removing active bets by single managers. Examining these effects may be done in two ways: either by focusing on the composition of the resulting portfolio, that is, on the indirect exposures to stocks being held in the equity mutual funds,[1] or by estimating the resulting (expected) relation between the return of the portfolio and the benchmark.[2]

In our study, we investigate the properties of portfolios built using equity sector ETFs first by the resulting weight of the stocks contained in the sector ETFs and the benchmark and second by the measured return co-movements of the portfolios with the benchmark. Here, the benchmark is simply the composite index containing all the companies that are included in the sector ETFs. We are able to assess the implications from both the compositions and the resulting effects of them on the constructed return series regarding the index relation by this approach.

We review studies concerning portfolio building including funds and the problems mentioned above in the next section. Weight-focused measures for analyses of portfolio compositions and the methodology used are presented in Section 3.

Empirical results are presented in Section 4, followed by the conclusions in Section 5.

2 Building portfolios including funds—Basic problems and studies

Studies regarding the building of portfolios of funds or FoFs are large in number and span the whole universe of possible fund types. We review funds of equity (mutual) fund studies in this section as these are most related to the research work presented in this study.

In a composition-related critique of FoF building, Connelly (1997) introduces what he calls the "law of unintended indexing" and "portfolio deadweight" when investing in several equity fund management styles. He argues that mixing equity fund managers and therefore exposures to assets differing in strength at least partially offsets bets by active managers. As a result, the portfolio holdings' deadweight increases. Although Connelly's critique focused on active bets versus passive investments, in this paper we analyze whether these effects are present in portfolios containing purely passive managed funds, namely (sub-)index exchange-traded funds (ETFs). We review the measure in Section 3.

Research employing actual fund data on a holdings level is provided by Gallagher and Gardner (2006), who study holdings of U.S. equity mutual funds and institutional funds to analyze active bet erosions in multi-manager portfolios. Their holdings-based analysis suggests significant countering in active bets as well as implications of inefficiencies in blended portfolios due to in-group trading between similar funds and their peers.

While there exist some studies aiming at discussions and analyses on fund compositions and their effects when being held in a fund portfolio, the majority of studies on FoF construction and on determining the "optimal" number of target funds to be included in a fund portfolio use (simulated) return analyses:

Several authors have investigated the optimal number of target funds to be included in a fund portfolio, as this choice is crucial with respect to the possibilities of obtain a diversified fund portfolio away from the designated benchmark and, ultimately, to beat it. O'Neal (1997),[3] Fant and O'Neal (1999), and Louton and Saraoglu (2006) investigate whether and how much different managers should be allocated for setting up diversified portfolios.

Analyzing different types of mutual funds (equity, bond, balanced, and money market) and simulating possible terminal wealth outcomes for the respective categories and asset classes, Louton and Saraoglu (2006) find a significant reduction in terminal wealth variation when investing in about six funds within a fund investment objective category. However, they do not find superior performance versus benchmarks when holding multiple target funds. The reduction in terminal wealth variability observed by Louton and Saraoglu roughly mirrors the findings of O'Neal (1997) and Fant and O'Neal (1999).

Examining Australian equity funds, Brands and Gallagher (2005) find that only six funds are needed to reduce the variability most significantly, that is, diversification benefits appear to be strongest when increasing the holdings up to a number of six funds, with more funds being added resulting in minor additional benefits. Louton and Saraoglu (2006), however, find benefits at higher numbers when using portfolios that include several investment objectives.

Yet, despite the common findings in the reduction in risk or variability, the performance or relative performance analyses results are mixed. This is consistent with the findings of Stein and Rachev

(2010) who, although reporting significant reduction in time series variability of returns for six to eight equity funds, find underperformance of style-neutral FoFs versus the benchmark.

In general, findings of underperformance versus benchmarks for example by Louton and Saraoglu (2006) and Stein and Rachev (2010), suggest a justification of the critiques by Connelly (1997)—whose deadweight argument is used in this study as well—and DiBartolomeo (1999), who stresses the danger of underperformance in decentralized multi-manager portfolio solutions: as FoFs with increasing numbers of funds included are merely exposed to the benchmark, costs shift the performance below it. It is interesting to see whether strong co-movement is apparent for portfolios consisting of ETFs as well.

From our brief review of the literature, it is obvious that mixing funds appears to remove both extreme outcomes as well as specific characteristics in multi-manager portfolios and FoFs. However, while most of those studies focus on the possible return outcomes through simulation analyses using reported time series of returns, the respective holdings of the funds investigated and therefore the resulting simulated overall holdings were not analyzed in many studies, with Gallagher and Gardner (2006) being among the exceptions. This is in contrast to research interest especially in the investment industry however, where considerable attention is given to compositions—and the lack of empirical evidence using holdings data may be attributed to lack of data rather than research focus. Fortunately, we can analyze holdings in our study as we use ETFs which report their full composition.

3 Portfolio deadweight and methodology

In the study mentioned above, Connelly (1997) introduces the so-called portfolio deadweight score for any fund as the minimum portion of all assets to which one would have exposure when investing in a fund or the respective index. Put another way, portfolio deadweight is defined as the sum of the minima of the weight of each company i in either the index or the fund under consideration and is defined as $dw = \sum_{i=1}^{n} \min(w_{i,\text{index}}, w_{i,\text{fund}})$.

We show Connelly's original example in Table 1, augmented with one of our own. From the examples it is obvious that only the positions which the fund management is underweighting against the index reduce portfolio deadweight.

Connelly (1997) in his critique states that by investing in funds that have different styles and therefore bets against the index, a fund portfolio may end up being a costly index product. In Connelly's example (i.e., Example 1 in Table 1), such a situation may arise if a second fund is underweighted by 1% in positions 1 to 5 and overweighted by 1% in positions 6 to 10. An equal monetary allocation to these two funds would result in an indirect exposure of exactly 10% for each position, increasing the FoF deadweight to 100%. This is what Connelly labels the "law of unintended indexing".

With an understanding of portfolio deadweight, we now explain our methodology. In our case of using sector or subindex ETFs, we have no underweighting or overweighting by managers, but each sector ETF has a different composition because only the companies of the specific industries are included in the respective ETFs with their specific weightings in the sector ETFs. Therefore, when building portfolios using sector ETFs, increasing the number of sectors included in the portfolio normally increases deadweight, but we do not know how quick this has an effect and how severe the effects are. Accordingly, several different portfolios consisting of the sector ETFs must be constructed and compared with the index.

Table 1 Connelly (1997) and own example for portfolio deadweight.

Example 1, Connelly (1997)				Example 2			
Asset	Index	Fund	Deadweight	Asset	Index	Fund	Deadweight
1	10	11	10	1	10	20	10
2	10	11	10	2	10	20	10
3	10	11	10	3	10	20	10
4	10	11	10	4	10	20	10
5	10	11	10	5	10	20	10
6	10	9	9	6	10	0	0
7	10	9	9	7	10	0	0
8	10	9	9	8	10	0	0
9	10	9	9	9	10	0	0
10	10	9	9	10	10	0	0
Total	100	100	95	Total	100	100	50

In the following, each portfolio's deadweight score is being defined as the sum of the minima of all assets included in the portfolio via allocation to the sector ETFs. Equal-weighted portfolios serving us for the simulation are easily built by constructing weighting schemes for differing portfolio sizes: First the number of different sectors to be included is chosen, second the sectors to be included are chosen randomly and we use 1,000 portfolios for each size.[4]

With the purpose of the weight measures being to gain insight into how the inclusion of sectors affects the possibilities to have allocations that do not resemble the index, it is worthwhile comparing the composition-focused weight measures with numbers that are informative about the possible outcomes generated by the weightings. We run the regression on the index returns for all simulated portfolios, and calculate the beta of the portfolio with the index in the following standard way: $r_{\text{fof}} = \alpha_{\text{fof}} + \beta_{\text{fof}} r_{\text{index}} + \varepsilon_{\text{fof}}$.

From the analysis of the betas, we can see how the weight scores are linked to measurable exposure or co-movement, especially whether as one can expect that the beta of any fund portfolio will tend toward unity for increasing deadweight. We test the one-year betas using daily data. The time horizon is considerably short, and we believe our selection of one year is appropriate because it is sufficient to see how composition and co-movement with markets are linked. In addition, the ETF compositions are based on the date of composition reporting, and any further enlargement of the time horizon for the beta calculations would mean that the weightings were even further away at the end of the time series than when using an annual distance.

4 Empirical results

4.1 Data discussion

We use iShares ETFs for our composition-based analysis. The index used is the ETF on the STOXX Europe 600 index; the sectors in this index are represented by the respective 19 sector ETFs that track the performance of the sector subindices of the STOXX Europe 600 Indices.

The provider description of the ETFs is as follows:

"*iShares STOXX Europe 600 [Sector Name] (DE) is an exchange-traded fund (ETF) that aims to track the performance of the STOXX Europe 600 [Sector Name] Index as closely as possible. The ETF invests in physical index securities. The STOXX Europe 600 [Sector Name] Index offers exposure to the European [Sector Name] sector as defined by the Industry Classification Benchmark (ICB). It is a sub index of the STOXX Europe 600 Index. The STOXX Europe 600 Index offers exposure to large, mid and small capitalisation stocks from European developed countries. The index is free float market capitalisation weighted.[ ]*"

Our examination indicates that the ETFs track the performance of the (sub-)indices very closely, making the analysis possible using the ETFs rather than the indices themselves. This is highly practicable as well in the sense that ETFs are directly investable with less effort and cost than buying the basket of equities to mirror the index and thus is normally done by institutional investors to gain sector exposure. Accordingly, the use of ETFs is straightforward for a fund portfolio analysis, with ETFs representing the index exposure that can be directly accessed by investment managers. While Blitz *et al.* (2012) report underperformance of index-tracking funds and ETFs, this appears to be no problem for the ETF data used in our study with tracking error being mostly below 1%. Both compositions and return data are publicly available from the iShares homepage. Table 2 gives an overview on the sector ETFs and the index ETF.

4.2 Deadweight results

As described in Section 3, we calculate portfolio deadweight using equally weighted portfolios for portfolio sizes containing up to 19 sector ETFs. We discuss the results using the October 2012 weights in order to later be able to put the weights in relation to indexing effects for the following year span of October 2012 to October 2013. Figures 1 and 2 show how the building of the sector ETF portfolios affects the fund portfolio weight measures, where the results are sorted for the sake of brevity.

From the plots of the deadweight scores for each number of included sectors shown in Figure 1, we can see that the range of the deadweight to be incurred is very large. It is obvious that for an increasing number of sector ETFs included in the equally weighted portfolios, the deadweight score's base value increases. This means that by introducing more and more sectors, deadweight increases.

In addition, one can see that: (1) the curves are getting flatter and the variation in deadweight within a given number of included sectors is decreasing with an increasing number of sectors and (2) the distance between the lines is getting smaller for increasing number of sectors included.

Our results have a straightforward implication when it comes to sector inclusions in portfolios or mandates. First, the more sectors included, the higher the deadweight. Second, the more sectors already included, the higher the minimum deadweight to be incurred but the less the effect of any additional sector for the deadweight score.

Although these findings may not come as a surprise, it is interesting to see that even 80% deadweight is never reached, no matter which sectors are combined. This is due to the fact that the companies representing the subindices have weightings within the subindices that are different from those that constitute the whole index. Based on this and on the fact that we are always using equal weights in the FoFs, the indirect exposures to the companies in the constructed portfolio never exactly match the index weights.

Based on the weight measures, this could be good news for investors willing to diversify but still not purely resemble the index. This is implied as even when being invested in a large number of sectors,

Table 2 Overview of Stoxx Europe 600 ETFs.

Stoxx Europe 600 ETF	Total return 2012–2013 (%)	Total return 2006–2013 p.a. (%)	Std. deviation 2006–2013 p.a. (%)	Index minimum 2006–2013	Index maximum 2006–2013	Stocks in sector as of 2013	Largest entry as of 2013
Composite Index	22.89	1.95	22.07	48.34	115.42	600	2.58
Auto & Parts	52.09	12.67	44.26	54.71	188.96	14	30.34
Banks	28.97	−7.40	34.88	19.99	109.28	47	17.06
Basic Resource	−5.01	−1.85	42.34	41.32	157.77	22	24.52
Chemicals	18.61	16.98	24.82	73.71	219.51	25	24.89
Construction & Materials	33.83	0.69	29.71	44.57	133.51	26	16.55
Financial Services	40.06	−1.20	27.67	31.90	116.59	32	10.27
Food & Beverages	13.35	14.29	17.05	71.84	208.49	29	31.25
Health Care	22.33	7.01	16.62	63.30	152.08	34	21.99
Industrial Goods & Services	27.58	8.42	26.14	53.97	158.93	34	10.78
Insurance	35.31	0.27	32.24	29.84	111.94	36	13.51
Media	40.06	4.29	20.99	53.40	130.27	26	14.34
Oil & Gas	4.60	0.62	26.06	61.82	118.13	32	22.14
Real Estate	12.31	−4.11	25.77	25.90	117.91	26	21.10
Retail	26.88	3.15	21.10	54.61	122.07	28	15.18
Technology	34.91	0.52	26.21	44.49	119.75	25	25.39
Tele-Communication	31.90	5.06	20.67	72.44	136.73	23	29.06
Travel & Leisure	29.12	1.39	24.00	44.56	123.53	21	20.73
Utilities	9.56	−1.52	22.28	64.84	133.10	26	13.05

Note: Annual calculations refer to end of October dates. All data are as of October 2013.

the ETF portfolio does not result in pure index replication when pursuing equal weight portfolio building. This means that here the law of unintended indexing appears not to be strong enough that 100% deadweight may be reached. In addition, one could expect that asset allocation on a sector investment basis is done with only some sectors rather than with almost all of them—so equal weight sector portfolios may apparently be built without having severe effects of unintended indexing.

Figure 2 depicts the histograms of the deadweight scores for all possible numbers of ETFs to be included in the portfolio. These figures support the findings reported above, because the mean and the median move toward higher deadweight scores with increasing numbers of sectors included. It is obvious as well that the minimum deadweight that must be incurred is rising no matter the combination for larger numbers of sectors included.

4.3 Beta estimation results

Although the analysis on a composition basis is interesting and yields a considerably surprising result of only mediocre deadweight scores even when being invested in a large number of sectors, it is necessary to analyze the possible outcomes of the portfolios with respect to performance and index relation. Specifically, it is interesting to see

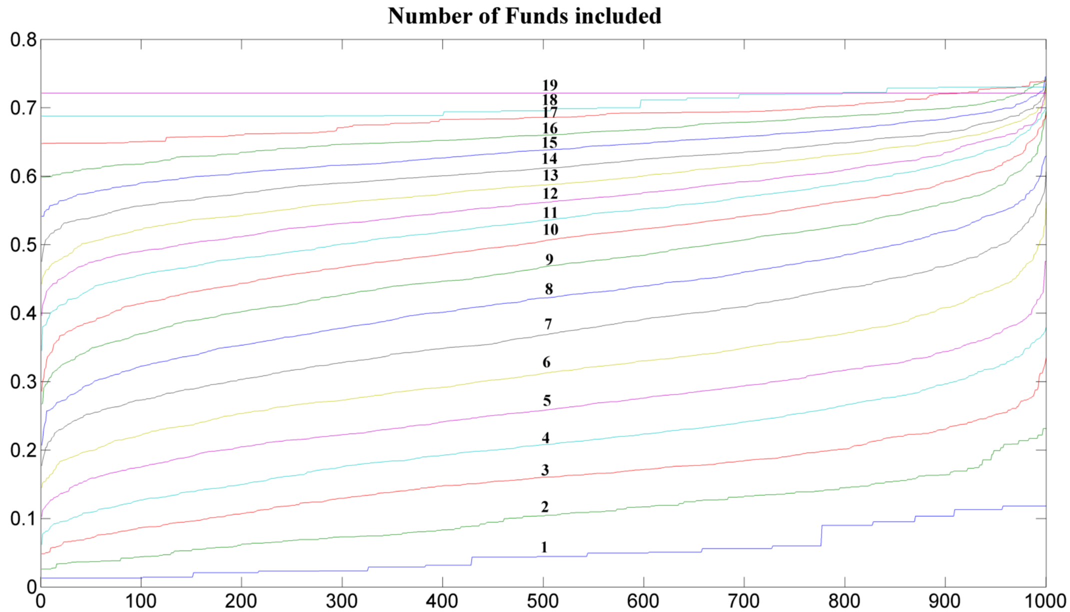

Figure 1 Sorted portfolio deadweight scores as of October 2012.

Note: The line at the bottom represents the case with only one sector invested, while the next lines above represent the simulated portfolios with one more sector ETF invested respectively. The top line is for the portfolio containing all 19 sector ETFs.

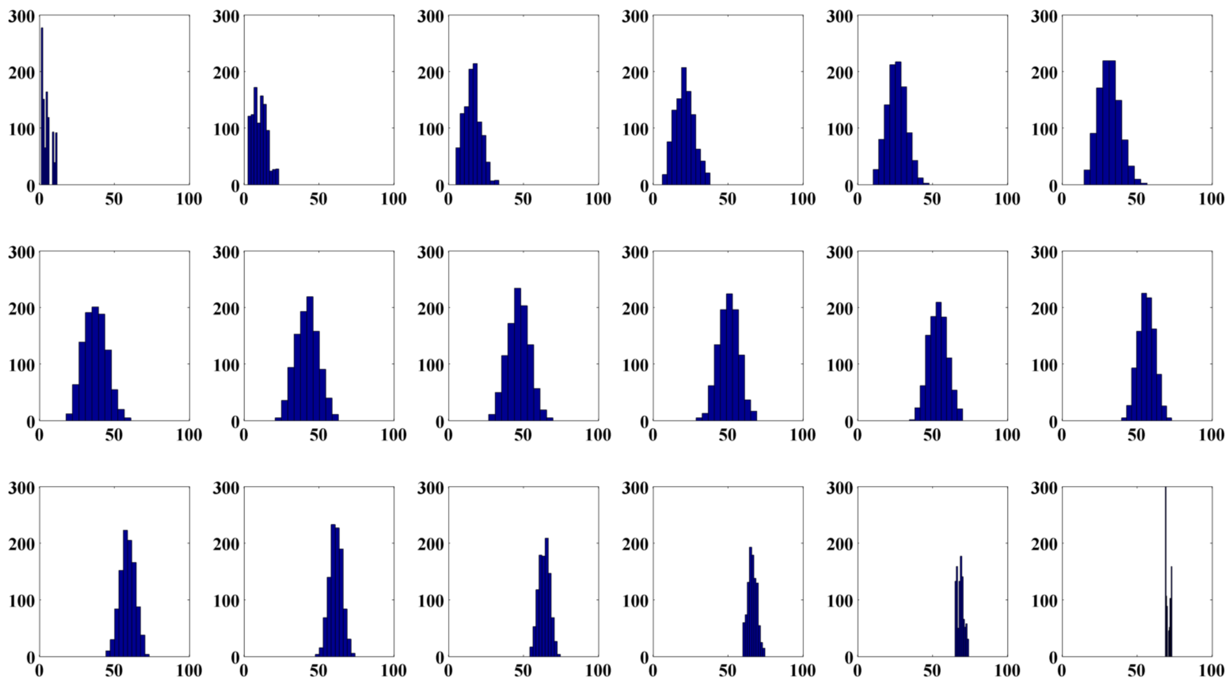

Figure 2 Histograms of portfolio deadweight scores as of October 2012.

Note: Increasing numbers of sectors from left to right and top to bottom. The bottom right plot is for portfolios with 18 sector ETFs.

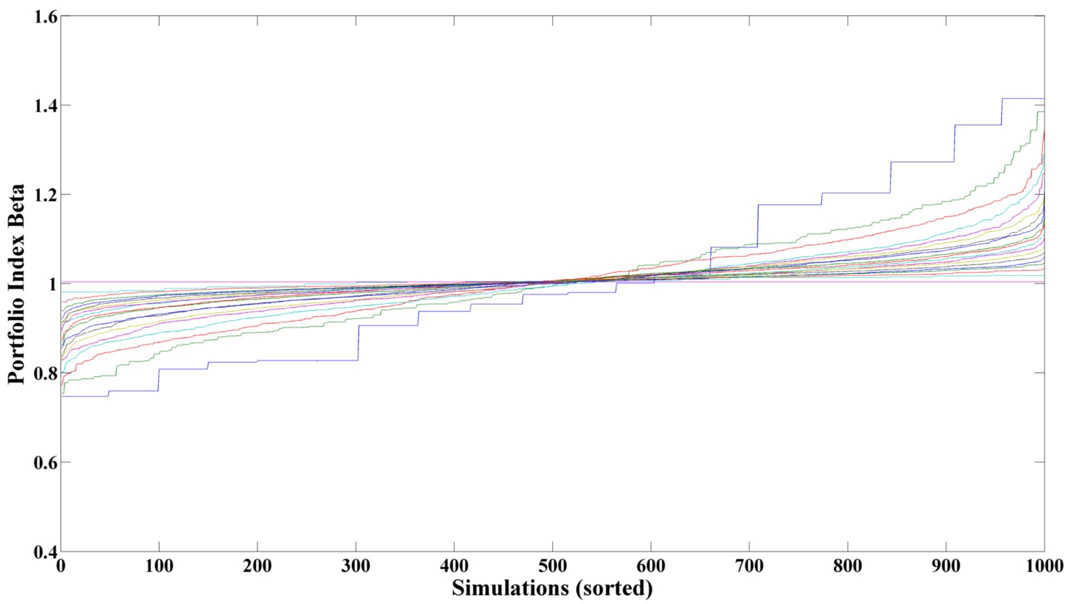

Figure 3 Sorted index betas (October 2012 to October 2013).

Note: The most dispersed patterns are obtained for smaller numbers of sectors included, i.e., the higher the number of ETFs in the portfolio, the flatter the curves and vice versa.

whether the deadweight score on October 2012 tends to imply us an underestimation of the forces that may lead to unintended indexing in the following year span of October 2012 to October 2013.

Figure 3 shows the betas for each number of sectors and all simulations, sorted from the smallest to the highest beta obtained from all 1,000 simulations of the respective 19 different numbers of sectors to be included. As can be seen, the vast majority of portfolios are in the 0.8–1.2 range, indicating that the sector FoFs are increasingly dependent on the returns of the index. Put another way, the moderate degree of deadweight does not mean that dependency on market movements is moderate as well. This becomes even more obvious from Figure 4, as the distributions of market betas are centered around unity rather quickly as the numbers of sector ETFs included increase. The percentage of simulated portfolios that have betas between 0.8 and 1.2 is above 90% for portfolios including seven or more sectors. Betas in the range of 0.9–1.1 are seen for 90% simulated FoFs including 14 sectors. Of all simulated FoFs for the 19 possible different numbers of sectors included with 1,000 simulations each, 90.1% have a beta in the range of 0.8–1.2, and 70.8% have betas in the even narrower range of 0.9–1.1. Omitting the simulations with only one sector included changes the percentages to 93% and 75.6%. Clearly, this shows the limits of being able to diversify without being exposed to unintended indexing, with fund portfolios increasingly producing index-related returns when more sectors are added.

Having analyzed the betas of all simulated portfolios, a look at the coefficient of determination of the regressions strengthens our findings that the weight measure while being informative regarding portfolio compositions seems to understate the effects of unintended indexing.

From Figure 5 it can be seen that only portfolios with five or less different sector ETFs have values below 90% (the sixth line from the bottom

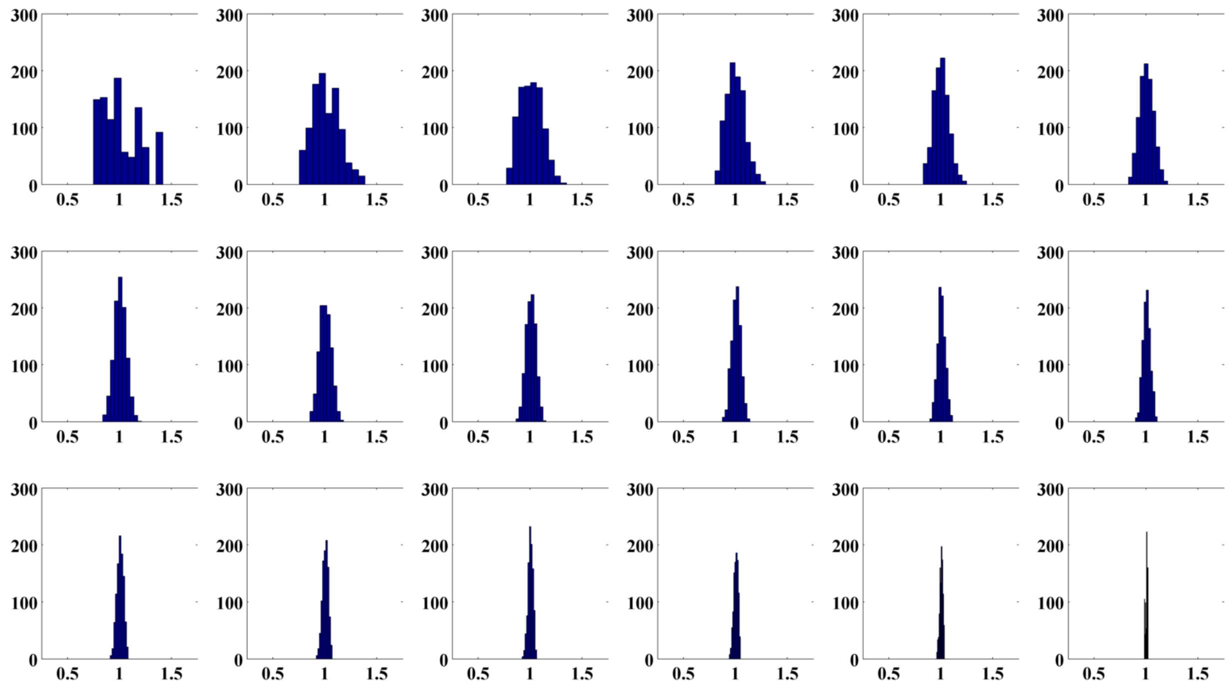

Figure 4 Histograms of portfolio index betas (October 2012 to October 2013).

Note: Increasing numbers of sectors from left to right and top to bottom.

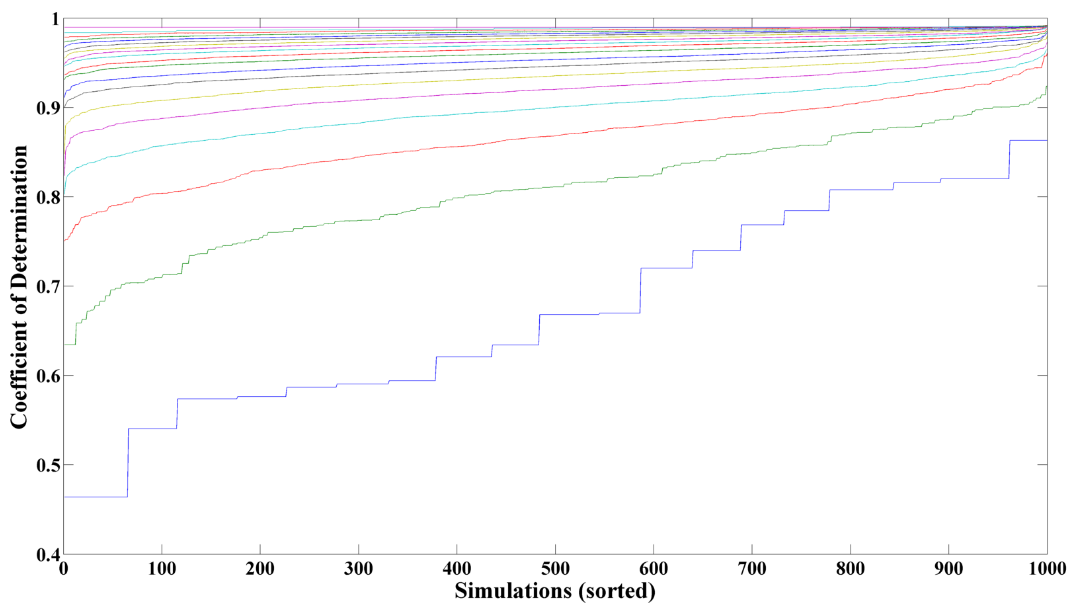

Figure 5 Sorted coefficients of determination (October 2012 to October 2013).

Note: Lowest and steepest patterns obtained for smaller numbers of sectors included, i.e., the higher the number of ETFs in the portfolio, the higher the explained part of variation in their returns and vice versa.

is above 90% for all simulations); therefore, the constant and the index returns explain most of the variation in the returns of the simulated portfolios at already low numbers of invested sectors.[5]

4.4 Linking scores and beta estimation results

From the analysis of the weight scores it can be seen that the sector portfolios may not have an alarming deadweight score at first glance, but tend to go along with index movements at already small numbers of different included sectors. Therefore, while seeing a clear but not very strong unintended indexing tendency from the weight analyses at already small numbers of sectors, co-movements between the sector ETF portfolios and the index appear to be strong already at low numbers of sectors. This shows up as well when interpreting the scatter plots between the portfolio deadweight score and the portfolio index beta in Figure 6, as the cloud of combinations is narrowing with increasing number of sectors included. In addition, the cloud appears to get compressed especially in the vertical direction, meaning that the betas for given deadweight are more centered around unity with more sectors invested.

4.5 Deadweight and unintended indexing over time

It is important to check whether the results from above are robust against changes in the sample, that is, for different market phases and over time. We calculated the respective measures for all years from 2006 to 2013 to analyze this. This results in 6 one-year spans for which we can calculate the weight measures for one year and relate it to the co-movement with the index in the following year. For example, we can analyze how the 2006 deadweight is behaving and how the 2006 to 2007 beta turns out, like we did for the 2012 deadweight and 2012/2013 betas in the detailed discussion above.

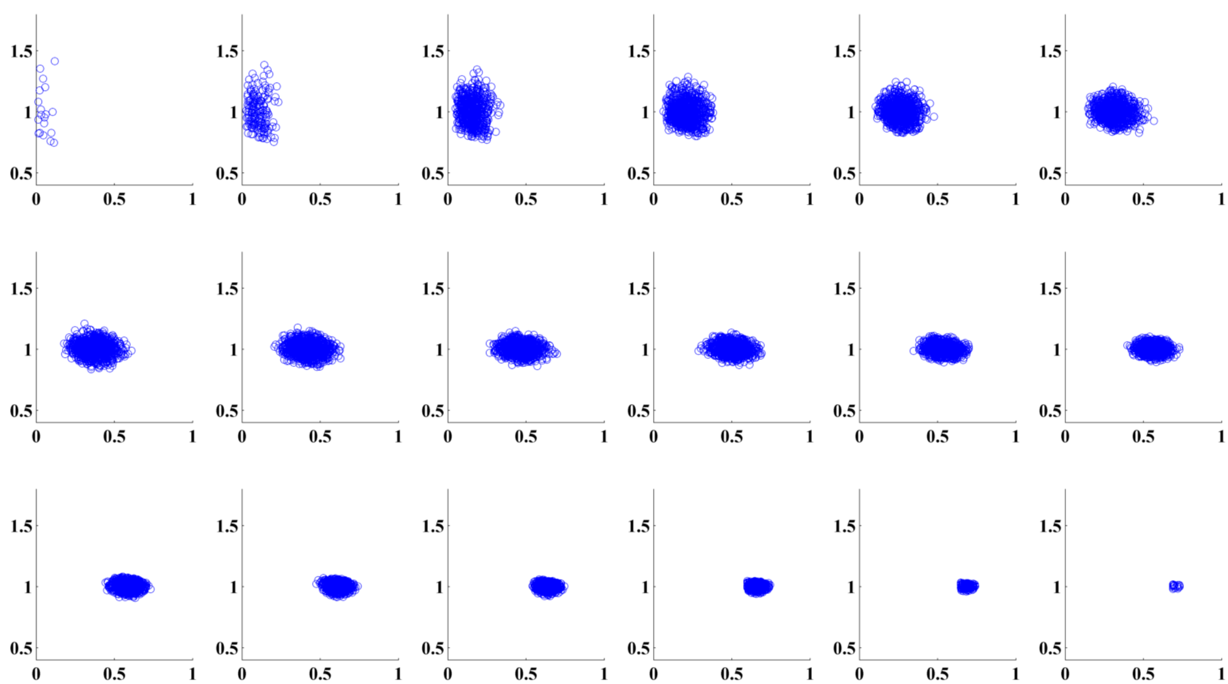

Figure 6 Scatter diagram of portfolio deadweight scores and portfolio index beta.

Note: Deadweight on x-axis, beta on y-axis. Increasing numbers of sectors from left to right and top to bottom.

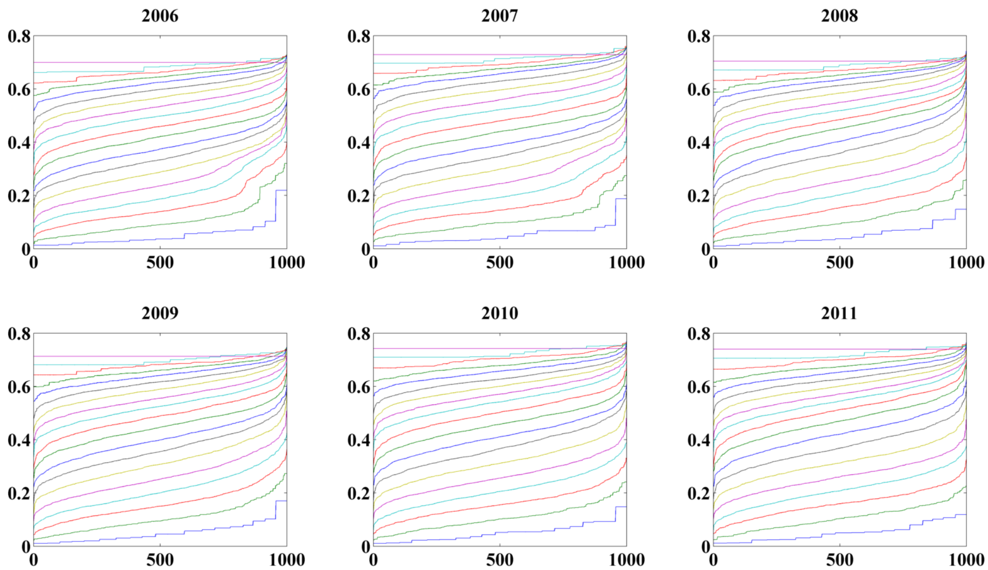

Figure 7 Sorted portfolio deadweight scores over time.

Note: The line at the bottom represents the case with only one sector invested, whereas the next lines above represent the simulated portfolios with one more sector ETF invested respectively, as annotated in Figure 1.

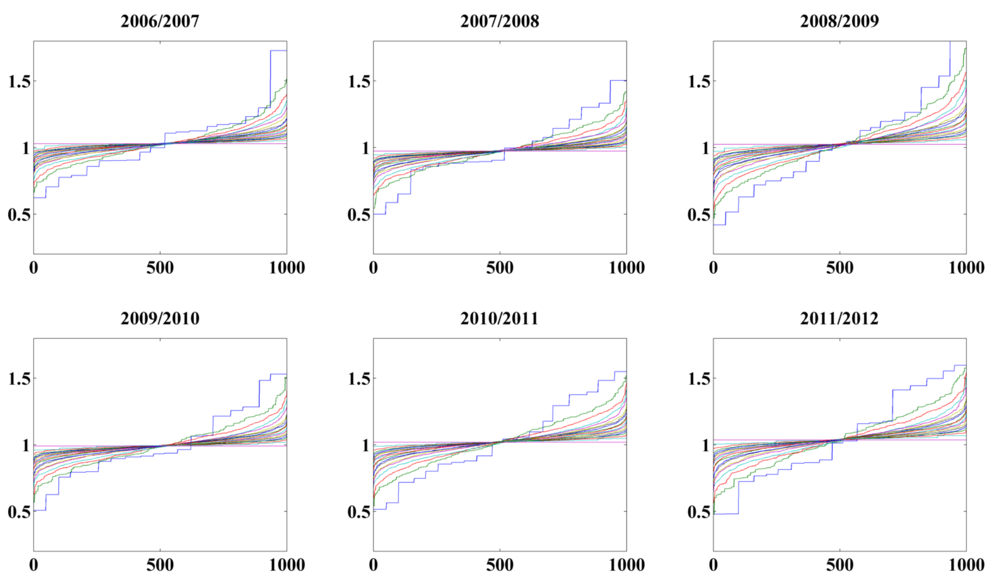

Figure 8 Sorted index betas over time.

Note: The most dispersed patterns are obtained for smaller numbers of sectors included, i.e., the higher the number of ETFs in the portfolio, the flatter the curves and vice versa.

For the sake of brevity we show only the most important results: Figures 7 and 8 are the counterparts of Figures 1 and 3 and show the sorted portfolio deadweight scores and the sorted index betas, respectively.

From the graphs it is evident that the effects found in the most recent available data from 2012 to 2013 appear to be present in other time periods as well. Although there is some variation of course, the apparently moderate degrees of intended indexing are contrasted by fairly quick replications of the index when investing in more than a handful of sector ETFs.

5 Conclusion and outlook

We use the deadweight score and standard beta estimation of simulated ETF portfolios with the index to gain insight into portfolio composition similarities and their effects on portfolio performance.

All analyses are carried out by generating simulated portfolios containing sector ETFs in equal weights for differing numbers of sectors included. The weight score measure being informative on the resulting compositions of the FoFs in comparison with the index implies only moderate degrees of unintended indexing.

This may lead to an underestimation of the comovement with the index for portfolios including several sectors, resulting from the fact that the separate company weights and exposures are summed up, neglecting the correlations between them that are crucial when determining the behavior of the fund portfolio on the aggregated level, rather than on the single component level.

The results and implications found for the most recent time span of October 2012 to October 2013 appear to be strengthened by the analysis over time: apart from some naturally occurring variations in the strength of effects, the results are generally the same during different market phases.

It can be seen that indeed the deadweight measure is not fully sufficient in determining the degree of unintended indexing and the countering of exposures, as the betas of the simulated portfolios tend to be closely around unity at already small numbers of sector ETFs included.

We can stress that on a composition basis the so-called law of unintended indexing may not be as strong as expected when using equal-weighted FoFs with different numbers of sectors included, but the co-movement between the portfolios and the market appears to be strong at already small numbers of sectors. Therefore, practitioners may be best advised to carefully select their target number of sectors and especially focus on few sectors to be included, rather than investing in too many sectors. Furthermore, basing decisions mainly on compositions is not recommendable, given the results found.

Notes

1 See, for example, Connelly (1997) and Gallagher and Gardner (2006).

2 See, for example, O'Neal (1997), Fant and O'Neal (1999), Park and Staum (1998), Saraoglu and Detzler (2002), Brands and Gallagher (2005), Louton and Saraoglu (2006 and 2008), Amo *et al.* (2007), Kooli (2007), and Stein and Rachev (2010).

3 The work by O'Neal (1997) is in general the analysis in the fund space that corresponds to the influential Statman (1987) study for stocks, the latter finding that 30 and 40 stocks need to be included for a diversified portfolio for borrowing and lending investors, respectively.

4 Of course, the 1,000 portfolios for the maximum number of ETFs to be included would all be the same when every ETF is contained, while on the other side one obtains approximately 1,000 divided by the number of total ETFs in the analysis of different portfolios when the maximum number would be 1.

5 The computed Durbin–Watson test statistic did not indicate strong structural problems with respect to autocorrelation when explaining the sector returns with the index returns.

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