WHEN SIZE DOESN'T MATTER:

EQUAL WEIGHTING

(VS. MARKET CAP WEIGHTING)

White Paper

January 2018

Executive Summary

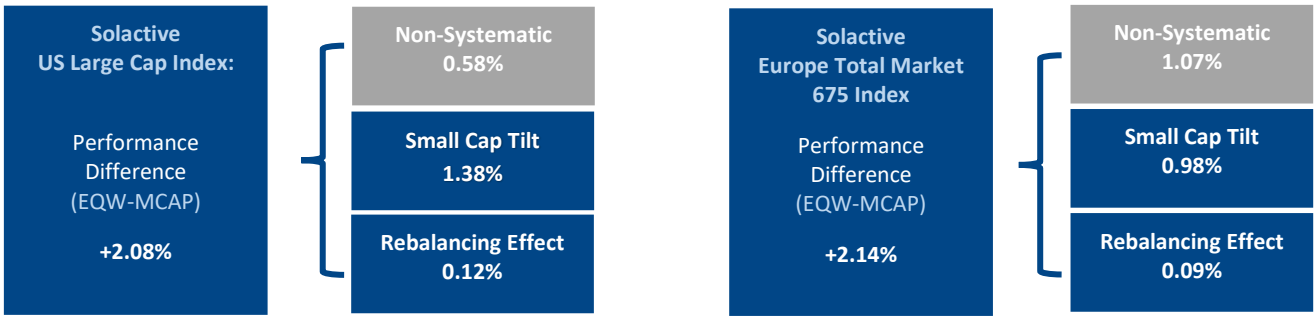
This report provides a detailed look at the equal weighting method (referred to as EQW in this paper), contrasted with the more traditional market capitalization (MCAP) method, in which securities are weighted proportionally to their market value. We analyze the impact of the two methods by comparing the following indices:

- Solactive US Large Cap Index and Solactive US Large Cap EQW Index
- Solactive Europe Total Market 675 Index and Solactive Europe Total Market 675 EQW Index

Over the test period (Feb 2000 – Oct 2017), we find that EQW portfolios outperform MCAP ones, exhibiting higher systematic risk but a faster recovery time. To better understand why, we closely examine EQW's characteristics:

Lower concentration risk	We show how EQW portfolios offer better diversification and decrease unsystematic risk.
Higher exposure to small cap stocks	On the other hand, higher exposure to smaller capitalization stocks results in broader market risk and actually causes EQW portfolios to display higher risk values. However, **the smaller capitalization stocks are also the main driver behind EQW's outperformance**.
Imbedded "buy low, sell high" feature	The better returns of the EQW method are also partly explained by what we call a "rebalancing effect" – i.e. bringing stocks back to equal weight, essentially buying low and selling high – something not present in MCAP weighted portfolios, whose components' weights flow with price movements and never need adjustments except for stock additions/deletions and extraordinary corporate actions.
Higher Turnover	Despite higher turnover costs, EQW demonstrates more than sufficient excess return to be viable.

Finally, we break down the outperformance of EQW over MCAP for both the United States and Europe:



In both the United States and Europe, most of the outperformance of EQW over MCAP weighting is explained by the higher exposure to small cap stocks, whereas the rebalancing factor only has a minor effect.

Although the size of a stock doesn't matter when allocating weights using the EQW method, the size factor eventually matters the most in generating the outperformance of EQW over MCAP weighted portfolios.

Introduction

There are several weighting schemes to choose from when constructing a portfolio or an index: price weighting, fundamental weighting, or factor weighting, to name a few. But one of the most common is the traditional market capitalization (MCAP) method (also known as value-weighting), in which securities are weighted proportionally to their market value: the larger the company, the larger the weight in the portfolio and vice versa. Another well-known method – which has gained more traction in recent decades – is equal weighting (referred to as EQW in this paper), in which all securities are given equal proportions, regardless of their market capitalization. Different weighting schemes will result in different properties for otherwise identical portfolios. In this paper, we analyze the characteristics of equal-weighting and contrast them to those of MCAP-weighting.

Characteristics of Equal Weighting

Weighting equally in contrast to weighting proportionally to MCAP results in different risk and return values at portfolio level. Similarly, risk factors' exposures such as sector and country will be different: in the case of EQW, these exposures simply depend on the number of stocks in each sector or country, whereas in the case of MCAP weighting, exposures depend much more on the size of the companies (no matter how many stocks there are in each sector or country). While these different exposures lead to different performance characteristics, they are specific to each case. From a more general perspective, the four features below could be expected of all equally weighted portfolios:

1. Lower concentration risk

Market cap weighting leads to overweighting the biggest companies in the portfolio. This tendency might not be desirable from a diversification perspective, as the performance of the entire portfolio can become highly dependent on just a few very large companies. Through equal weighting, this concentration risk is reduced, as all companies play an equal role in the performance of the portfolio.

2. Higher exposure to small cap stocks

In the same light, equal weighting leads to smaller stocks receiving higher weights relative to market-cap allocation. Consequently, equally weighted portfolios tend to display higher volatility and superior performance, since small caps tend to outperform large caps in bull markets but are prone to higher systematic risk.

3. An inherent "buy low, sell high" feature

Equal weighting results in selling shares of the stocks that rose in value, and buying more of the stocks that fell following the previous rebalancing – effectively locking in gains, and increasing exposure to the now cheaper stocks that previously underperformed. As such, equally weighting a portfolio can act as an implicit trading strategy that effectively takes advantage of mean-reversal in stocks if it occurs.

4. Higher portfolio turnover

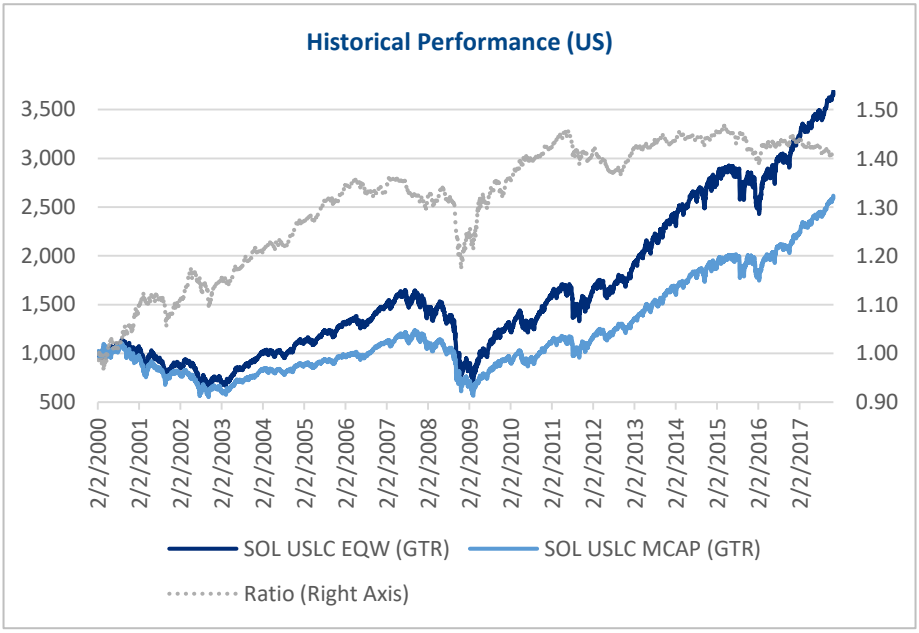
Assuming no stock additions or deletions between rebalancing periods, a purely MCAP weighted portfolio would not require adjustments. Under the same assumption and following the reasoning from our previous point (3), an equally weighted portfolio would still generate turnover unless all stocks display the exact same performance – a highly unrealistic scenario.

5. "Bonus" Characteristic: Outperformance

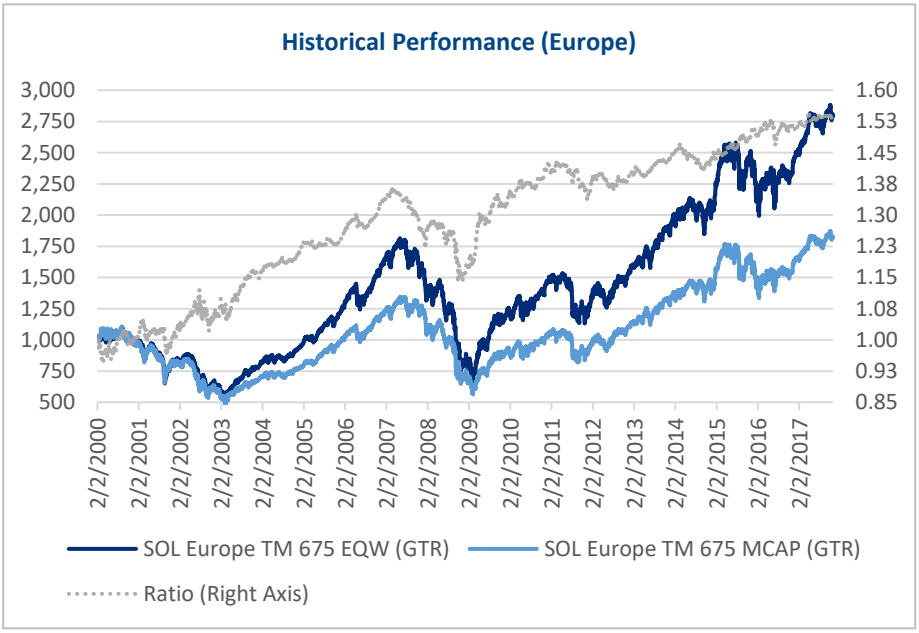
Empirical studies suggest that equally weighted portfolios tend to outperform their MCAP weighted counterparts over a long enough time horizon. In the following section, we verify the outperformance hypothesis, using Solactive Indices. Then, we analyze each of the aforementioned characteristics of EQW portfolios in detail. Finally, we break down the outperformance, to better understand how each of these traits might influence performance.

Empirical Analysis: Solactive Indices

We begin by examining the historical performance of EQW portfolios and MCAP weighted ones. The composition of the indices under direct comparison in this section is exactly the same – the only difference is the weighting. We conduct this analysis both for the United States and for Europe, using the **Solactive US Large Cap Index** as the starting universe for the former and the **Solactive Europe Total Market 675 Index** for the latter (these indices are rebalanced quarterly).

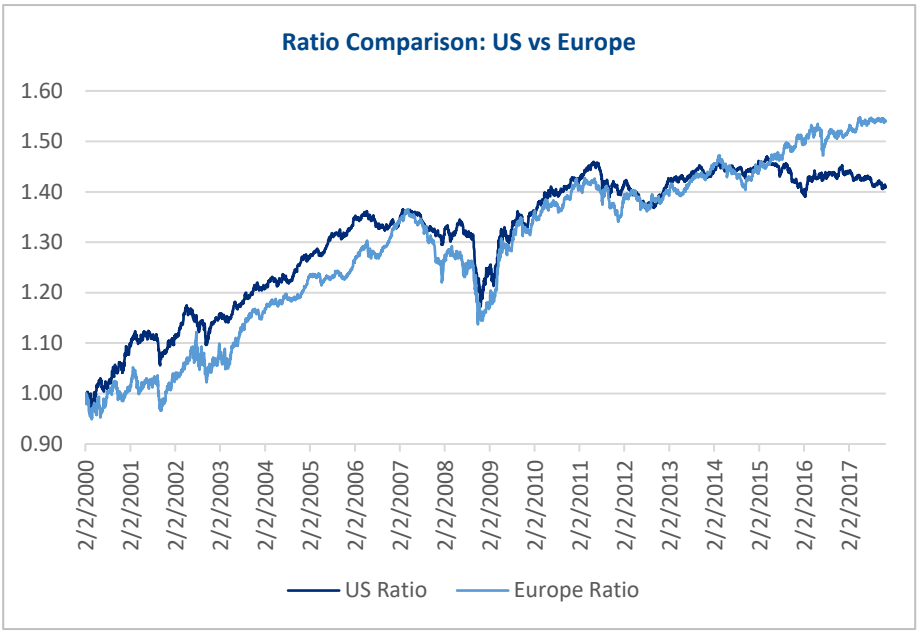


	SOL US LC Equal Weight (GTR)	SOL US LC MCAP Weight (GTR)
Mean	9.11%	7.03%
Standard Deviation	20.15%	19.03%
Maximum Drawdown	-58.43%	-54.36%
Sharpe Ratio	0.45	0.37



	SOL Europe 675 Equal Weight (GTR)	SOL Europe 675 MCAP Weight (GTR)
Mean	7.21%	5.07%
Standard Deviation	17.88%	18.98%
Maximum Drawdown	-63.34%	-58.21%
Sharpe Ratio	0.40	0.27

Over the period of evaluation (Feb 2000 – Oct 2017), the results confirm that EQW outperforms MCAP, both in the United States and Europe. At the same time, EQW also results in larger drawdowns for both markets. It is interesting to see that in the United States, EQW leads to higher volatility – as expected – but not in Europe, where volatility is lower, surprisingly. As we will see later in the paper (*Section 2: Higher Exposure to Small Cap Stocks*), smaller caps actually exhibit lower volatility in Europe (alongside higher returns) during the observation period.



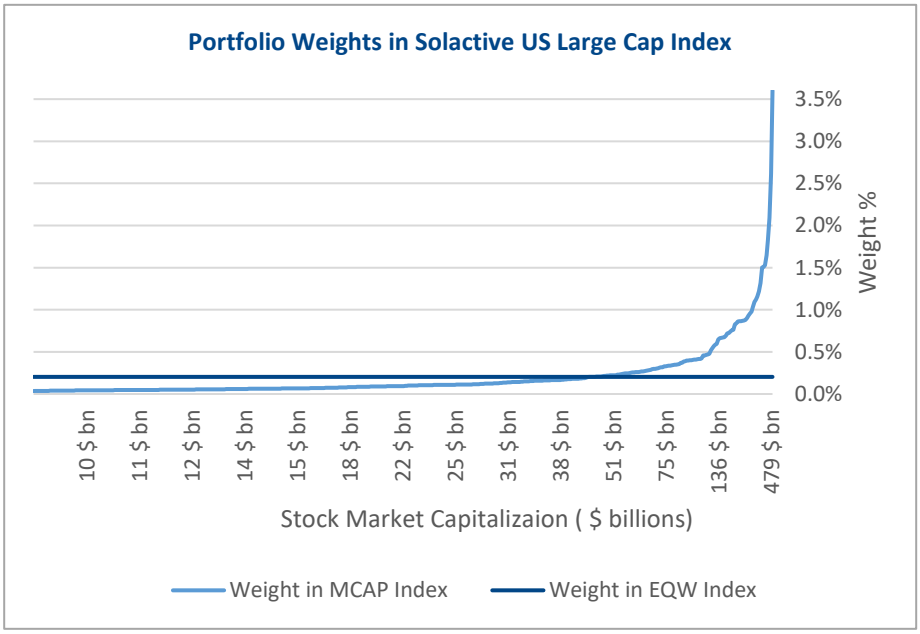
The outperformance ratios steadily increase during normal or up markets but decrease during market downturns. This result confirms that EQW portfolios fall more during bear markets but then recover faster, eventually overtaking MCAP portfolios even after the larger drawdowns incurred by EQW.

These ratios also reveal that even though United States and Europe are entirely different markets, the relative performance of EQW vs. MCAP remains similar regardless of the market – as it can be seen if the ratios are plotted against each other.

We now analyze the characteristics of EQW portfolios in detail, to better understand why and how EQW might outperform.

1. Lower Concentration Risk

It is broadly accepted that diversification is beneficial to portfolio construction. But does diversification refer solely to a large number of portfolio members from different sectors? No. The weights of the stocks play a key role. Even if MCAP and EQW portfolios share the same (large) number of stocks, MCAP weighting leads to a high concentration in the largest companies.



This concentration is visible in the graph to the left, in which we plotted the weights of all components in the Solactive US Large Cap Index.

In the case of EQW, we can see that all stocks play an identical role in the index, regardless of their market capitalization (x-axis, in $bn.).

Although both portfolios contain the same 500 stocks (current selection), the largest 15 companies in the MCAP weighted index account for 25% of the entire portfolio.

Would this concentration negatively affect the performance of the index?

In order to answer this question, we construct and back-test two portfolios – each representing 25% of the original Solactive US Large Cap Equal Weight and MCAP weighted indices respectively (which share the same composition). We rank the securities in the composition according to their market capitalization, and start including the largest ones in these two portfolios, until the sum of their original weights in the MCAP and EQW Indices respectively sums up to 25%.

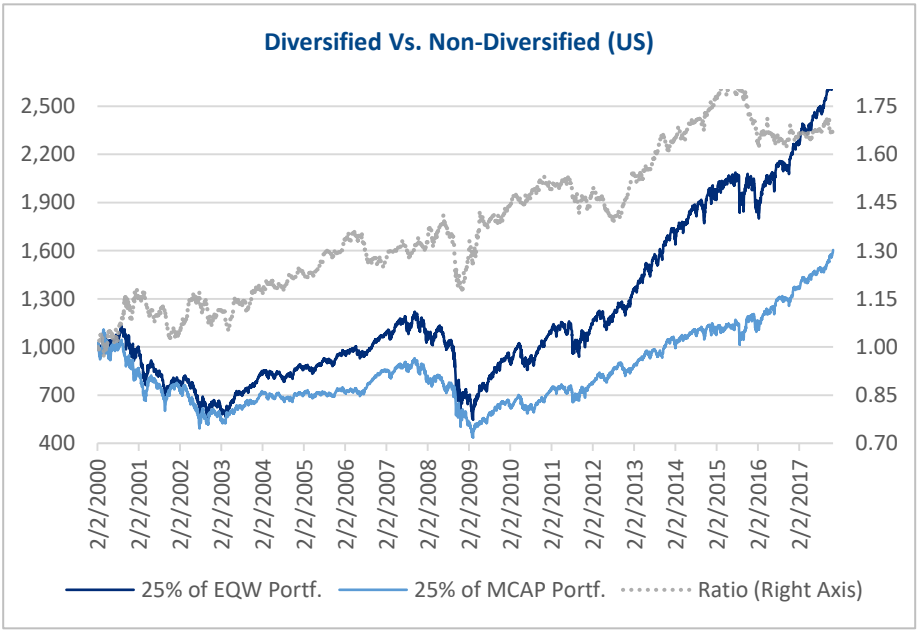
Portfolio 1 – 25% of EQW Portfolio

- Composed of the largest securities in the Solactive US Large Cap Index, whose aggregate weight in their "parent" **Equal Weight** Index sums up to 25%.
- **Around 125 stocks per selection date.**
- Represents our **diversified** portfolio
- Components are equally weighted

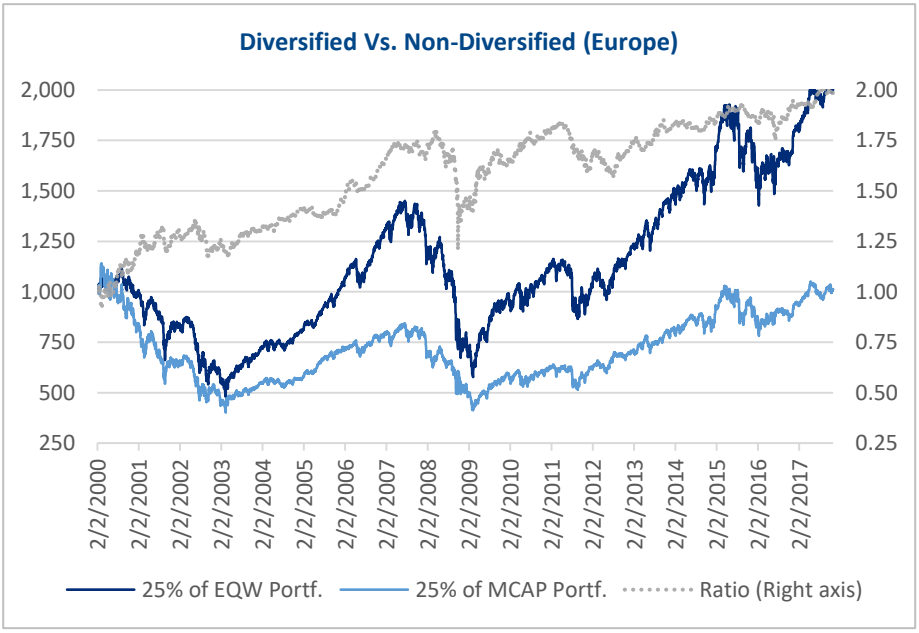
Portfolio 2 – 25% of MCAP Portfolio

- Composed of the largest securities in the Solactive US Large Cap Index, whose aggregate weight in the original MCAP weighted index sums up to 25%.
- **Fewer than 20 stocks per selection date.**
- Represents our **non-diversified** portfolio.
- Components are equally weight

We can observe the large difference in the number of securities that make up 25% of the MCAP and EQW indices. Namely, 25% of the risk and return of the entire MCAP portfolio is dictated by fewer than 20 stocks. On the other hand, 25% of the risk and return of the EQW portfolio depends on around 125 stocks (in the case of Solactive US Large Cap). We extend this analysis to Europe as well, and compare the performance of each portfolio below:



	Portfolio 1 Top 25% EQW US @125 stocks	Portfolio 2 Top 25% MCAP US @20 stocks
Mean	7.15%	4.40%
Standard Deviation	19.14%	19.15%
Maximum Drawdown	-55.22%	-60.73%
Sharpe Ratio	0.37	0.23



	Portfolio 1 Top 25% EQW Europe @165 stocks	Portfolio 2 Top 25% MCAP Europe @20 stocks
Mean	5.71%	2.03%
Standard Deviation	19.73%	19.83%
Maximum Drawdown	-60.20%	-64.88%
Sharpe Ratio	0.29	0.10

In line with modern portfolio theory, the risk-adjusted returns of Portfolio 1 seem higher due to lowering the unsystematic risk generated by each individual stock. While in this case, the diversification effect might very well have contributed to the superior performance of Portfolio 1 (25% of EQW), we cannot draw this conclusion as we didn't control for size: the smaller-cap tilt might have caused outperformance as well. The hint is given by the performance ratios (both for the United States and Europe), which decrease during down markets – something reminiscent of small cap behavior.

On the other hand, a tilt towards smaller-caps would theoretically imply higher volatility and larger drawdowns. Our results reveal that standard deviation is almost the same for Portfolios 1 and 2 (actually slightly lower for Portfolio 1, in both markets), whereas the maximum drawdowns are actually significantly lower for Portfolio 1 (25% of EQW). We can thus confirm the intuition behind the diversification effect – less risk.

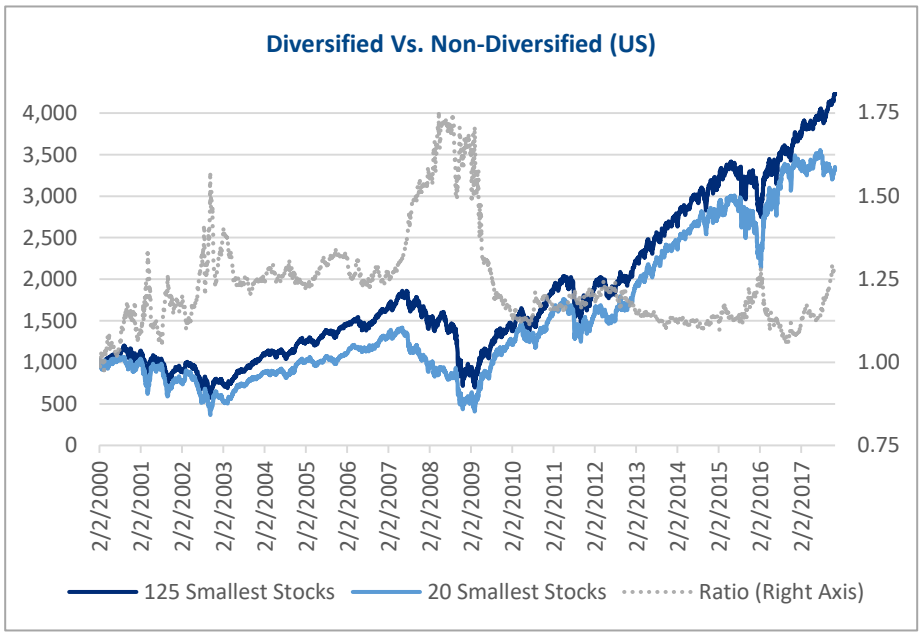
To better understand whether the diversification effect actually helps with performance (or if it is only the small-cap tilt contributing), we construct these portfolios in the opposite way: for the Diversified Portfolio (Portfolio 1), we select the 125 smallest stocks instead of the 125 largest (125 stocks for the United States and 165 stocks for Europe). Similarly, for the Non-Diversified Portfolio (Portfolio 2), we include the 20 smallest stocks instead of the 20 largest (fewer than 20, actually – we include the same number of stocks as before).

Portfolio 1 – Diversified Portfolio

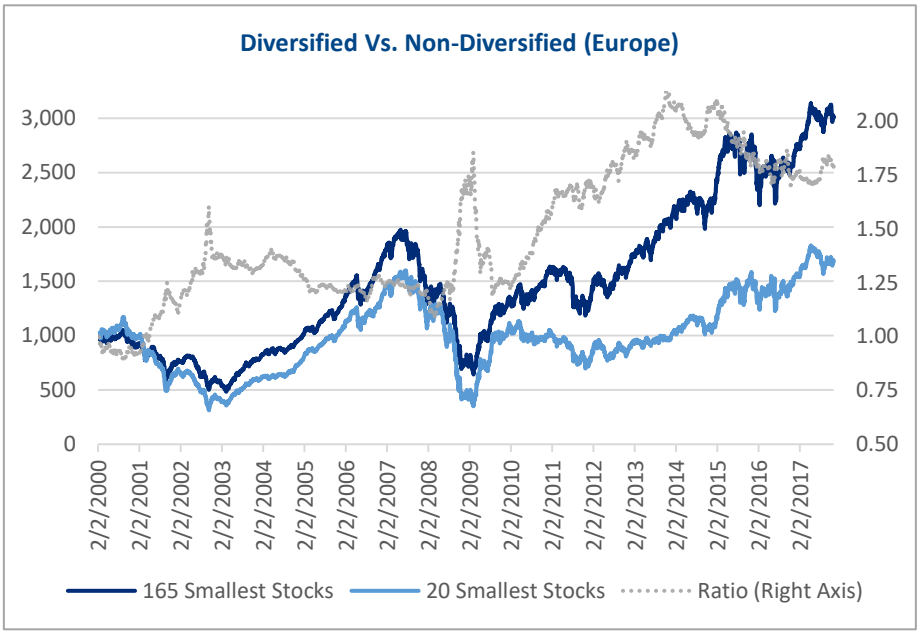
- **US: 125 smallest stocks** at each selection date
- **Europe: 165 smallest stocks** at each selection date (same number of stocks as before)
- Components are equally weighted

Portfolio 2 – Non-Diversified Portfolio

- **Fewer than 20 stocks** per selection date (same number of stocks as before)
- Components are equally weighted



	Portfolio 1 125 Smallest Stocks US	Portfolio 2 20 Smallest Stocks US
Mean	10.23%	10.19%
Standard Deviation	21.71%	26.98%
Maximum Drawdown	-62.52%	-71.05%
Sharpe Ratio	0.47	0.38



	Portfolio 1 165 Smallest Stocks Europe	Portfolio 2 20 Smallest Stocks Europe
Mean	7.57%	5.22%
Standard Deviation	17.78%	21.76%
Maximum Drawdown	-67.42%	-78.12%
Sharpe Ratio	0.43	0.24

As we show in the next section, smaller caps outperform large caps in the US and Europe. In this light, it could be expected that Portfolio 2 outperforms Portfolio 1, since the market capitalization of Portfolio 2 is smaller. However, it is Portfolio 1 (Diversified) that outperforms both in US and Europe. Volatility and maximum drawdowns are also significantly lower for the Diversified Portfolios in both markets. The spikes in the ratios during the 2008 crisis confirm that the outperformance is due to less risk and downside movement. Since the ratios do not decrease during bull markets (they stay constant in the United States and increase in Europe), we can infer that the ratio spike in 2008 is not due to a larger cap tilt of Portfolio 1 (Diversified).

2. Higher Exposure to Small Cap Stocks

By construction, an EQW portfolio exhibits a substantially higher exposure to smaller cap stocks than a MCAP portfolio. Historically, small caps generally show better performance. This characteristic is also intuitive: smaller companies have more room to grow. This fact leads to the assumption that the higher exposure to small caps probably accounts for a substantial part of the outperformance of equally weighted portfolios – an assumption that we will test in the final part of this paper, when we break down the outperformance of EQW over MCAP portfolios.

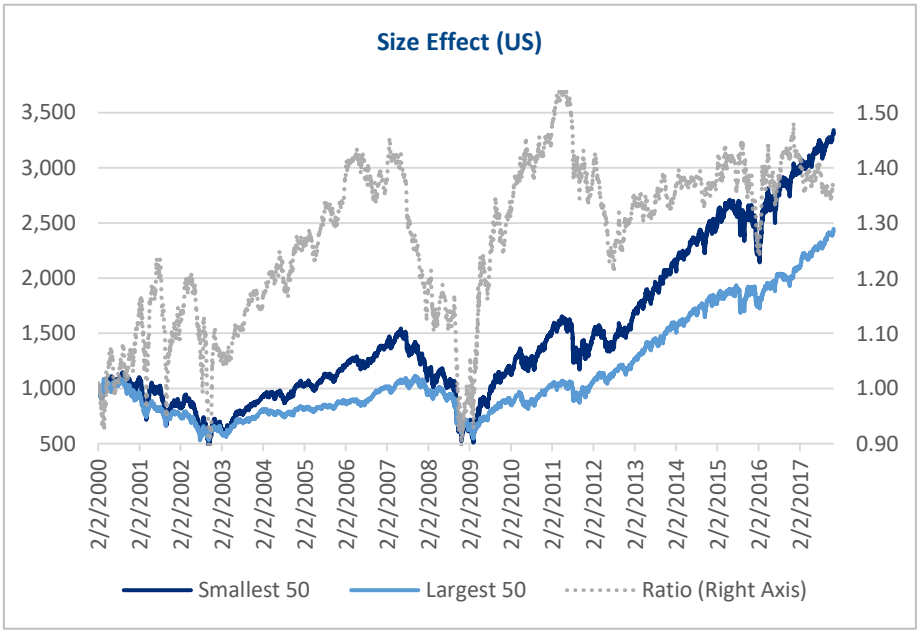
Here however, we examine whether this size effect also occurs within relatively large caps – i.e. test if the smallest large-caps outperform the largest large-caps. The reason for this analysis is the following: when comparing EQW and MCAP weighting schemes using real-world Solactive indices, all the stocks in the composition will be relatively large. Thus, we again construct two portfolios (actually four, since we are analyzing the size effect both for the United States and for Europe):

Portfolio 1 – Smallest 50 Stocks

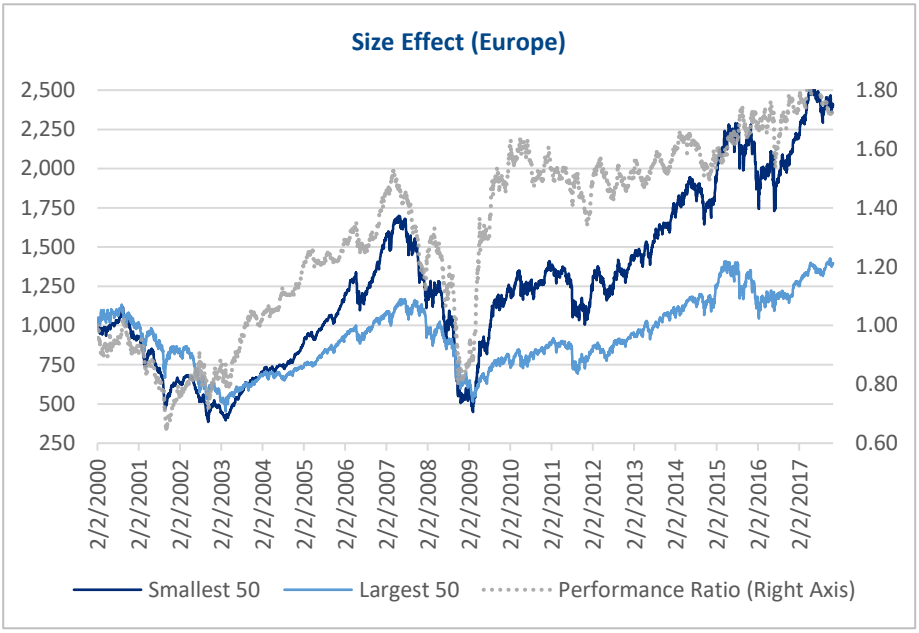
- composed of the 50 smallest securities in the Solactive US Large Cap Index, and in the Solactive Europe Total Market 675 Index respectively.
- Components are equally weighted

Portfolio 2 – Largest 50 Stocks

- composed of the 50 largest securities in the Solactive US Large Cap Index, and in the Solactive Europe Total Market 675 Index respectively.
- Components are equally weighted



	Smallest 50 (US)	Largest 50 (US)
Mean	9.33%	6.54%
Standard Deviation	23.63%	18.39%
Maximum Drawdown	-66.90%	-50.93%
Sharpe Ratio	0.39	0.36



	Smallest 50 (Europe)	Largest 50 (Europe)
Mean	6.84%	3.92%
Standard Deviation	19.61%	20.54%
Maximum Drawdown	-73.64%	-60.02%
Sharpe Ratio	0.35	0.19

The ratios in both markets (United States and Europe) reveal that the 50 smallest capitalization stocks perform worse during bear markets but also recover much faster after downturns end, catching up and eventually overtaking the 50 largest capitalization stocks. At the same time, these smaller cap stocks exhibit significantly larger drawdowns than the large caps – still, they reach a higher level to fall from.

In the United States, the 50 smallest capitalization stocks act as expected: higher return potential and volatility, though the trade-off indicated by the Sharpe ratio is still advantageous. While in Europe they do offer better returns, the smaller capitalization stocks are also surprisingly less volatile (and display a Sharpe ratio almost twice as good), explaining why the EQW portfolio in Europe is less volatile than the MCAP weighted portfolio.

An important consideration: due to the higher exposure to smaller capitalization stocks, an EQW index can have lower investment capacity. This fact is especially relevant for ETFs, which might find an EQW index more difficult to replicate. It is also relevant for mutual funds or institutional clients who need to satisfy high capacities of investments.

3. An Inherent "Buy Low & Sell High" Feature

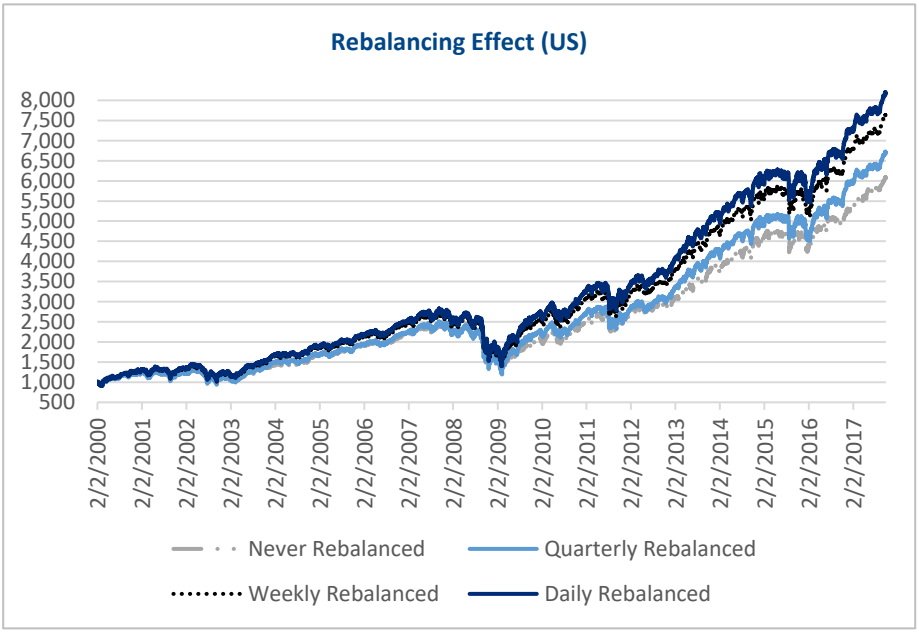
Stock prices rise and fall over time. Assuming no component changes (i.e. no stocks in or out of the portfolio), **a purely MCAP weighted portfolio would not require weight adjustments from rebalancing to rebalancing**, as the weights dictated by MCAP are already reflected in the share prices – when a stock rises, its weight in an MCAP portfolio would also rise, and vice-versa.

Under the same assumption, **maintaining equal weights among portfolio components still requires adjustments**: selling some shares of the stocks that appreciated in value, and buying more shares of the stocks whose prices fell. As a result, any gains are effectively locked in, and are simultaneously used to increase exposure to the now cheaper underperformers. This characteristic of an EQW portfolio is essentially a "buy low, sell high" trading strategy. If mean reversal in stock prices occurs, an EQW portfolio is perfectly positioned to take advantage of this process and generate better returns over time.

In summary, we can say that an MCAP weighted portfolio is never adjusted (overlooking component additions or deletions), whereas an EQW portfolio requires ongoing adjustments to maintain equal weight amongst its components. To test whether this frequent portfolio rebalancing actually locks in gains and takes advantage of mean-reversal, we again build different portfolios: one that is never rebalanced, and three that are increasingly frequently rebalanced (quarterly, weekly, and daily).

In order to isolate the effect of bringing stocks back to equal weight, we assume no component changes to the portfolio and thus only include stocks that survived in the composition since the start of the simulation. We are aware of the resulting look-ahead bias (explaining the very high index levels), but – again – we intend to isolate the rebalancing effect alone.

The composition of the following four portfolios is identical (169 stocks that survived in the Solactive US Large Cap Index since 2000), and all portfolios start equally weighted. The only difference is the rebalancing frequency.



	Never Reb. (US)	Qtrly. Reb. (US)	Weekly Reb.(US)	Daily Rebal. (US)
Mean	11.51%	12.17%	12.91%	13.30%
Standard Deviation	17.73%	18.70%	18.95%	19.00%
Maximum Drawdown	-50.74%	-52.26%	-51.56%	-50.39%
Sharpe Ratio	0.65	0.65	0.68	0.70

The daily rebalanced portfolio displays the highest returns, followed by the weekly rebalanced, quarterly rebalanced, and finally the never rebalanced portfolios.

Of course, the turnover cost should not be neglected, which would reduce (if not entirely negate) any excess returns generated by the "rebalancing effect". For more on turnover, see the next section of this paper.

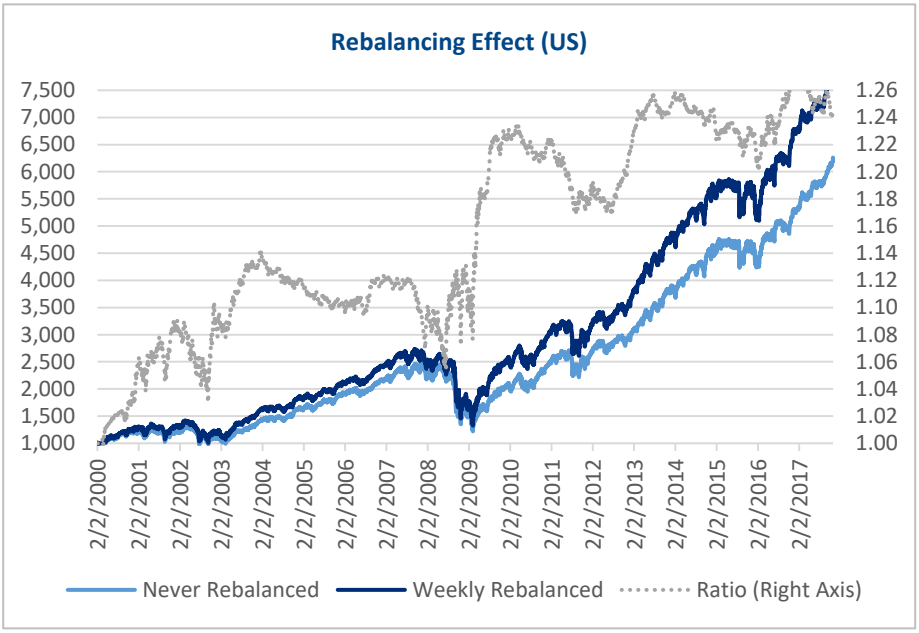
In the graphs below, we focus on the never rebalanced vs. the weekly rebalanced portfolios, in order to display the performance ratios, which suggest that the frequently rebalanced portfolio works best in times immediately after crises or in sideways markets.

Portfolio 1 – Never Rebalanced

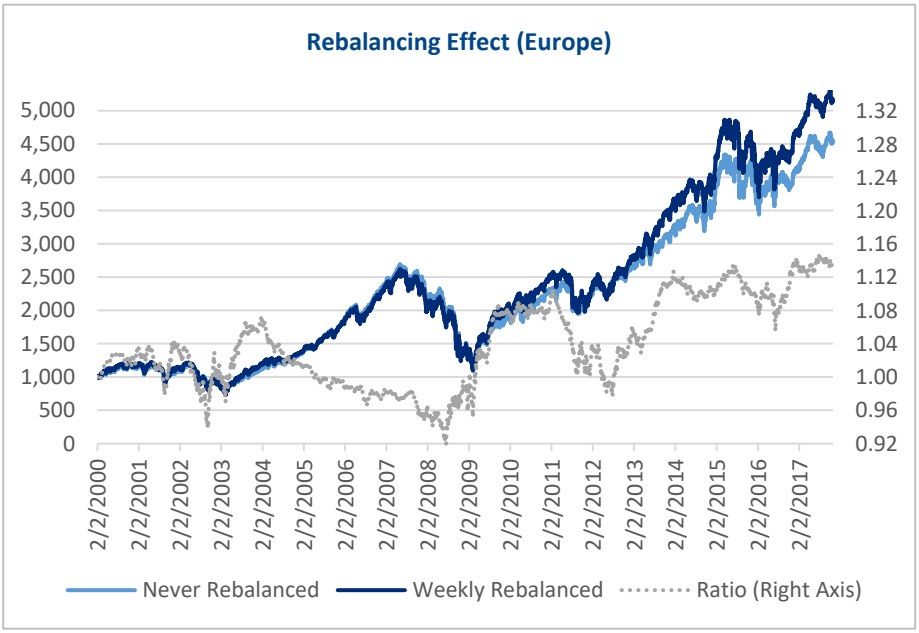
- composed of all the securities that remained in the Solactive US Large Cap Index (and in the Solactive Europe Total Market 675 Index) since 2000
- never adjusted

Portfolio 2 – Weekly Rebalanced

- composed of all the securities that survived in the Solactive US Large Cap Index (and in the Solactive Europe Total Market 675 Index) since 2000
- stocks brought back to equal weights weekly



	Never Reb. (US)	Wkly Reb. (US)
Mean	11.51%	12.91%
Standard Deviation	17.73%	18.95%
Maximum Drawdown	-50.74%	-51.56%
Sharpe Ratio	0.65	0.68



	Never Reb. (Europe)	Wkly Reb. (Europe)
Mean	9.64%	10.70%
Standard Deviation	16.98%	19.00%
Maximum Drawdown	-57.34%	-58.25%
Sharpe Ratio	0.57	0.56

According to these simulations, frequently bringing components back to equal weight has a noticeable, positive effect on performance (though volatility and drawdowns increase). Furthermore, the more frequent the rebalancing, the better the returns. Interestingly, our tests reveal that these results hold even when the portfolios start with MCAP weights, and are then frequently brought back to these initial MCAP weights. However, an important aspect to consider are the turnover costs (covered in the next section), which might render this "frequent rebalancing factor" impossible to capitalize on.

4. Higher Portfolio Turnover

As aforementioned, the weights of market cap weighted portfolios adjust automatically with share price changes and require redistribution of weights only under certain circumstances such as mergers or other extra-ordinary events. In the case of equal weighting, the portfolio requires regular weight redistribution in order for the components to remain at equal weight.

Hence, an EQW portfolio will always imply higher turnover than a MCAP weighted one, regardless of the rebalancing frequency – evident if we take a look at the average one-way turnover (per adjustment) of the following Solactive indices:

Solactive US Large Cap Index **(MCAP)**

3.62% mean one-way turnover (since 2000)

Solactive Europe Total Market 675 Index **(MCAP)**

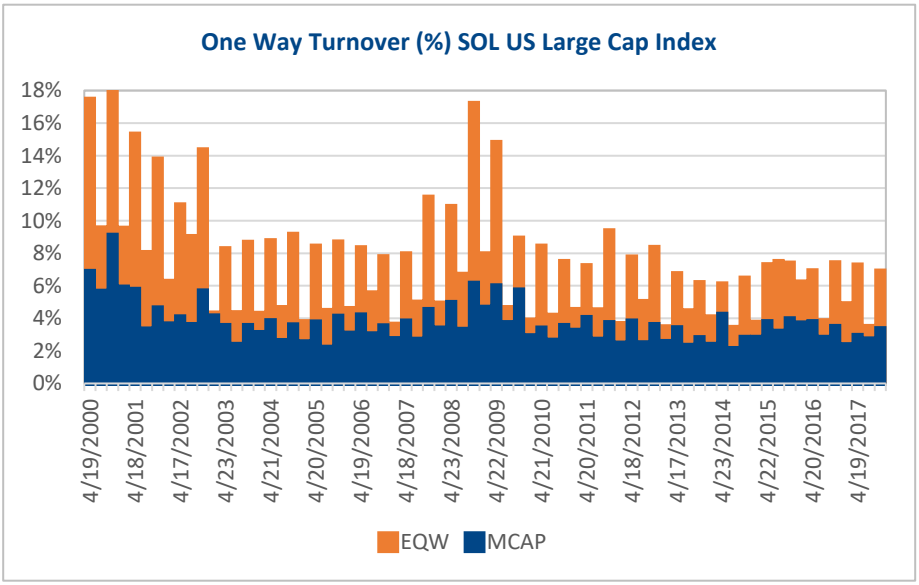
8.54% mean one-way turnover (since 2000)

Solactive US Large Cap **EQW** Index

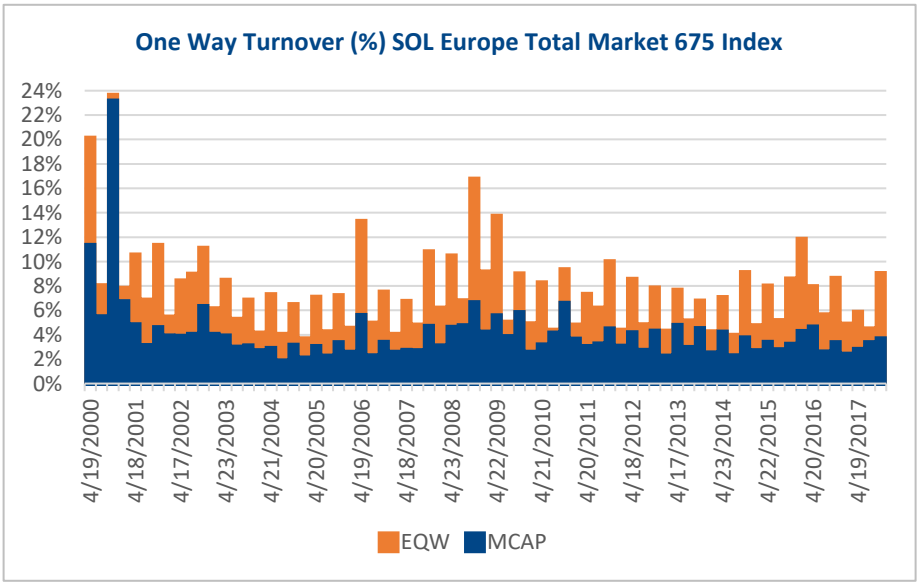
7.38% mean one-way turnover (since 2000)

Solactive Europe Total Market 675 **EQW** Index

18.11% mean one-way turnover (since 2000)



Thus, EQW portfolios imply higher transaction costs, which can make the difference between success and failure. As an example, we can take a look at the first attempts to launch equal-weighted funds in the 70s. At that point in time, the transaction costs were considerably higher, and the trading procedure more difficult, leading to the establishment of the MCAP weighting scheme as one of the most common.



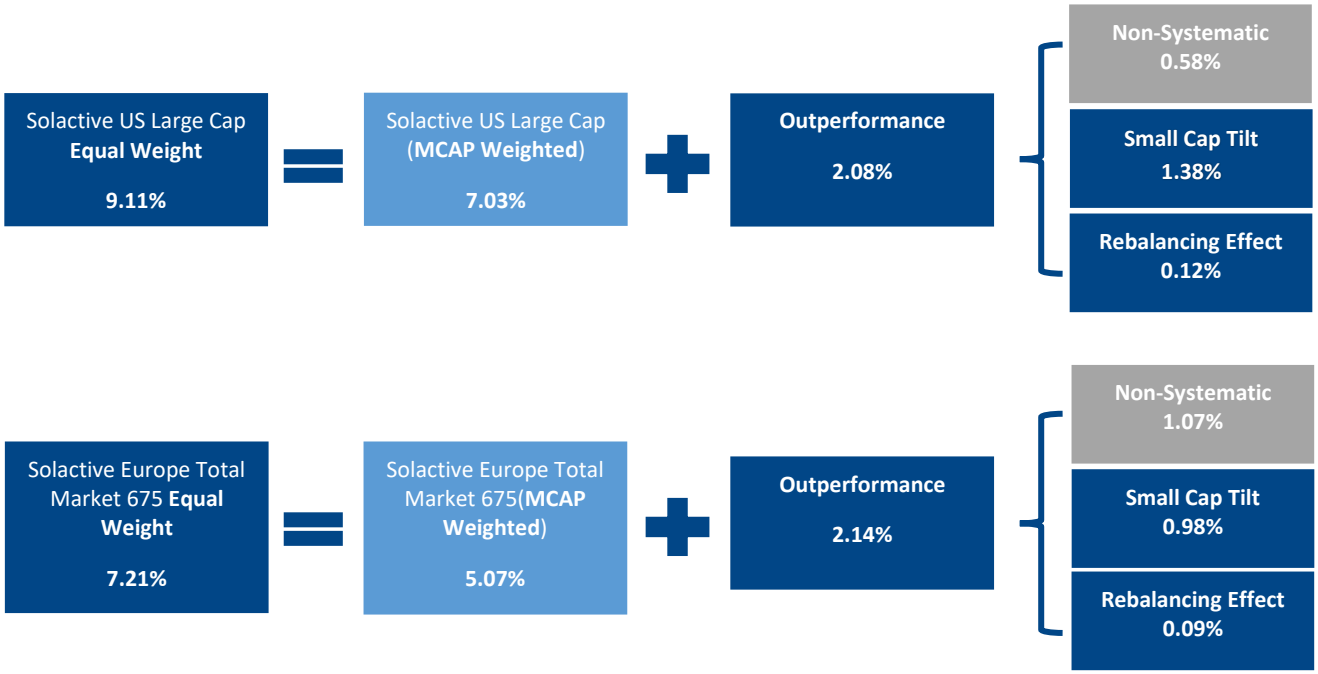
Today, however, transaction costs are significantly lower, making the equally weighted portfolios more viable than in the past. Even if we assume a very conservative transaction cost of 50 basis points (the transaction costs for non-retail traders can be less than 10 bps), the extra costs incurred by the quarterly rebalanced EQW portfolios would still be less than the excess returns generated through weighting stocks equally.

Outperformance Decomposition

Having established that EQW portfolios outperform MCAP weighted ones, and having analyzed their characteristics in detail, we now decompose the outperformance in line with the points mentioned above, in order to better understand why and how exactly they outperform:

1. Lower Concentration Risk (diversified vs. non-diversified portfolios)
2. Higher Exposure to Smaller-Cap Stocks (small vs large cap portfolios)
3. Inherent "Buy Low, Sell High" Feature (frequently vs unfrequently rebalanced portfolios)

In order to break down the outperformance, we need to construct different portfolios, treating each of these points as factors. However, a problem immediately arises: the non-diversified portfolio is part of the diversified portfolio, and we cannot build the other portfolios within these two. Furthermore, there is much overlap between our size and diversification factors. Thus, we simply focus on the size factor and ignore the diversification one. The results are as follows:



In the case of both Solactive US Large Cap and Solactive Europe Total Market 675, most of the outperformance generated by weighting equally is explained by the higher exposure to small cap stocks, whereas the rebalancing factor only has a minor effect.

In the United States, the small cap tilt explains about two thirds of EQW's outperformance over MCAP, while in Europe it explains slightly less than half. The rebalancing effect only explains about 5% of the performance difference in both markets.

To conclude, a stock's size does not matter when weighting portfolios equally – all components receive the same proportions regardless of size (in contrast to MCAP weighting). On the other hand, it seems that size is the most important factor when it comes to the outperformance generated by the equally weighting.

Appendix: Outperformance Decomposition

To decompose the excess returns of EQW over MCAP portfolios, we need to construct portfolios within portfolios treating each of these points as factors:

1. Lower Concentration Risk (diversified vs. non-diversified portfolios)
2. Higher Exposure to Smaller-Cap Stocks (small vs large cap portfolios)
3. Inherent "Buy Low, Sell High" Feature (frequently vs unfrequently rebalanced portfolios)

Non-Diversified				Diversified			
Smaller Caps		Larger Caps		Smaller Caps		Larger Caps	
Weekly Reb. *(Portf. 1)*	Annual Reb. *(Portf. 2)*	Weekly Reb. *(Portf. 3)*	Annual Reb. *(Portf. 4)*	Weekly Reb. *(Portf. 5)*	Annual Reb. *(Portf. 6)*	Weekly Reb. *(Portf. 7)*	Annual Reb. *(Portf. 8)*

As previously mentioned, we focus on the size factor and ignore the diversification one, since we cannot build the other portfolios within the Diversified/Non-Diversified ones and since there is considerable overlap anyway between the size and diversification factor as we have defined it earlier.

Smaller Caps		Larger Caps	
Weekly Reb. *(Portf. 1)*	Annual Reb. *(Portf. 2)*	Weekly Reb. *(Portf. 3)*	Annual Reb. *(Portf. 4)*

Hence, we build four portfolios: 50% smallest stocks rebalanced annually, 50% smallest stocks rebalanced weekly, 50% largest stocks rebalanced annually, and 50% largest stocks rebalanced weekly (see left). All portfolio members are equally weighted.

We have back-tested each of these four portfolios and obtained daily returns for each. We construct the well-known SMB factor (Small minus Big) and our "Rebalancing Factor" in the following way:

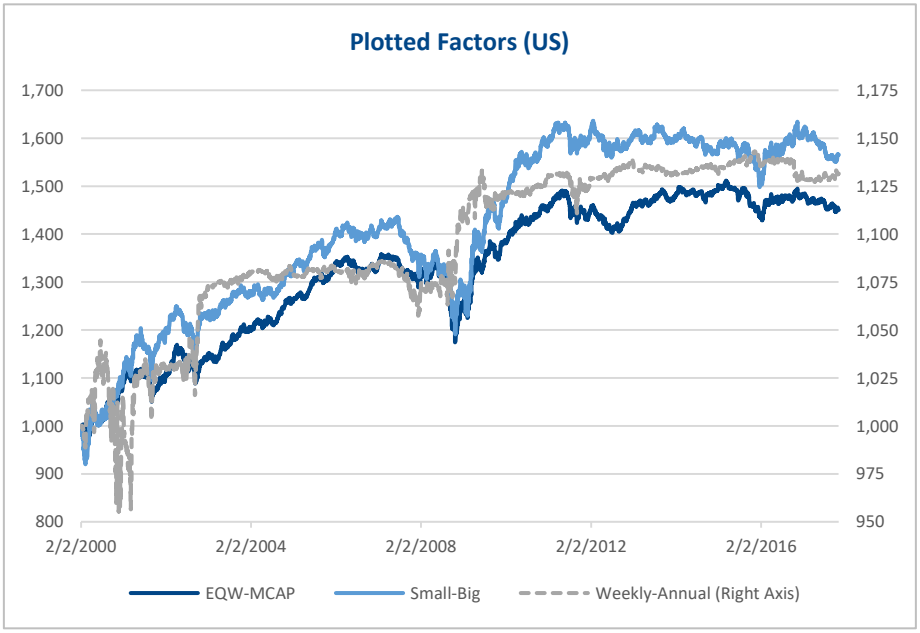
Small Minus Big (daily returns) =
$[(Small_{Weekly} + Small_{Annually}) - (Large_{Weekly} + Large_{Annually})] \div 2$

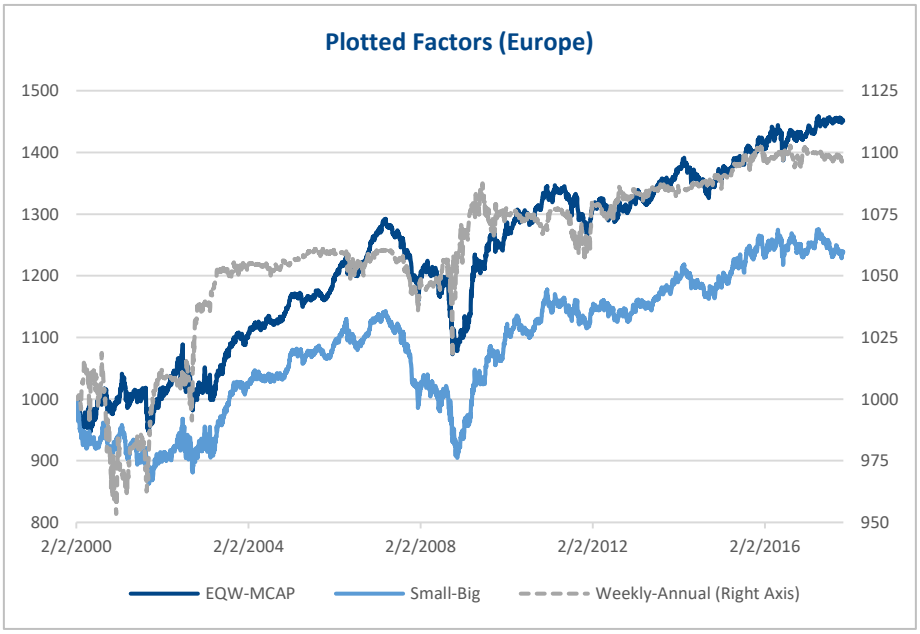
Weekly Minus Annual (daily returns) =
$[(Small_{Weekly} + Large_{Weekly}) - (Small_{Annually} + Large_{Annually})] \div 2$

Over our back-test period (Feb 2000 to Oct 2017), going long on the 50% smallest companies in the Solactive US Large Cap Index while shorting the 50% largest yielded an annual mean return of 2.56%. In the case of Solactive Europe Total Market 675 Index, the size factor displayed a return of 1.33% per year. Going long on the weekly rebalanced portfolios and shorting the annually rebalanced portfolios yielded 0.70% per year in the United States and 0.51% in Europe.

Regressing the returns of these two factors on the excess returns of EQW over MCAP, the size factor displays a beta of 0.54 in the US and 0.74 in Europe. The rebalancing factor exhibits a beta of 0.18 in the United States, and 0.17 in Europe (both factors are statistically significant @ 95%).

In order to better visualize how these factors performed since the year 2000, we plot the effect of these excess returns on a starting level of 1,000 (see below). Furthermore, we also plot the performance of going long on EQW and shorting MCAP (EQW-MCAP, also starting at 1,000). Please note that the rebalancing factor is plotted on the right axis, due to its lesser magnitude.





These graphs summarize and strengthen our previous findings:

- EQW-MCAP drops during market downturns, but grows during bull markets.

- Small-Big displays similar behavior.

- Interestingly, Weekly-Annual acts the same way, dropping during the financial crisis. The explanation is that the rebalancing effect is a double-edged sword: it will keep increasing exposure to dropping stocks. If mean reversal occurs, the 'rebalancing effect' would work in our favor, but if these stocks keep dropping to the point of bankruptcy, the "rebalancing effect" would actually increase losses.

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All numbers are calculated by Solactive as of Q4 2017.