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Implementation of alternative index weighting to Warsaw Stock Exchange

Keywords: Smart Beta, Alternative indexing, Quantitative weighting, ETF.

J E L Classification: G11.

Abstract: Exchange Traded Funds are the fastest growing segment of investment management business. Over last eleven years ETF's AUM grew over 2,000% This paper explores growing popularity of this investment vehicle and getting to the genesis of index tracking funds and to the roots of indexing, bares shortcomings of most common weighting scheme – capitalization weighting. Those flaws caused the rise of quantitative investing. The author reviews the literature in search of the most relevant Smart Beta definition and the reasons why this new investment concept is blooming nowadays. The substance of this paper is presentation of most popular alternative weighting schemes and exploration of their pros and cons by implementing those solutions to polish index WIG20. The impact of alternative weighting on performance of the index and its features has been synthesized and evaluated. In the result of this analyses and comparison cap-weighted WIG20 turned out to be the less effective weighting scheme.

▪▪▪ Introduction

Exchange Traded Funds, Smart Beta strategies, alternative weighting schemes are lately very hot topic among the economists, investors and asset managers. Growing popularity of those new investment vehicles goes along with growing

number of publications praising or pointing the flaws of new solutions. This paper tries to get to the roots of this growing popularity and find the genesis of alternative indexing. The literature presents many weighting schemes but which of them are worth implementation? Reviewing the publication of experts like Arnott, Malkiel or EDHEC-Risk Institute, four major alternative schemes has been chosen to present, implement and evaluate. Whether Smart Beta is a revolutionary new concept or just a new wine in old bottles, we can observe those strategies booming right now. Almost every major asset management company launched their own Smart Beta ETFs. Is it just the marketing gimmick or those alternatives have more to offer to the investors than just a hype? The purpose of this study is an attempt to answer those questions by implementing new weighting schemes to Polish index WIG20 and comparison with traditional cap-weighted approach.

The research methodology and the course of the research process

The paper contains empirical analysis and descriptive research studies carried out in several steps. First step looks into growing popularity of ETFs and genesis of indexing. Than reviewing the literature defines Smart Beta and describes quantitative investing. Finally, paper focuses on implementation of alternative weighting schemes to WIG20 index. Given the results of the prior studies, the following hypothesis was formulated:

Hypothesis 1.: *Implementation of alternative weighting schemes to Warsaw Stock Exchange may improve index's performance.*

GPW database has been used to find the monthly mean return rates of WIG 20 components. 43 months period (since January of 2013) has been analyzed. Author calculated covariance matrix, Sharpe ratio, correlation matrix and standard deviation of the portfolios using Microsoft Excel sheet. Than depending on the weighting scheme the allocations has been optimized using Solver function. Created indices has been simply evaluated, by short term performance comparison and described, by emphasizing their specific features. The study ends with conclusions achieved by literature review and analysis of created portfolios.
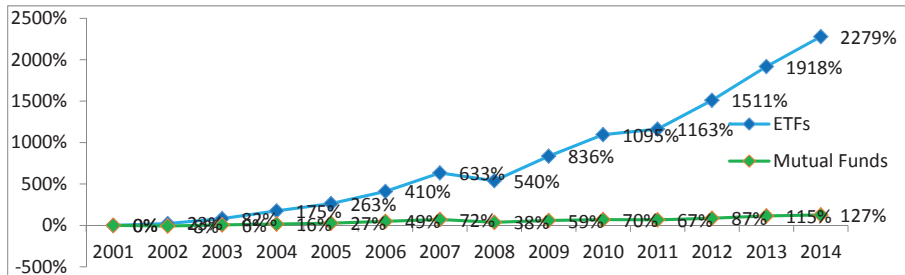
Growing popularity of ETF's

Exchange Traded Funds have been introduced 26 years ago. In that time ETFs evolved from rather niche investment vehicles to the fastest growing segment of investment management business. Nowadays they are highly appreciated by financial advisors, investment managers and asset owners. ETFs became even core holdings for some open ended investment funds. Their advantages and simplicity made them a powerful tool for almost every portfolio management strategy. As can be seen on Figure 1 ETF's AUM grew rapidly over the last eleven years. From only 416 US$ Bn to nearly 3,000 US$ Bn.

Figure 1. Global ETF Growth 2005–2016

Source: http://www.etfgi.com/.
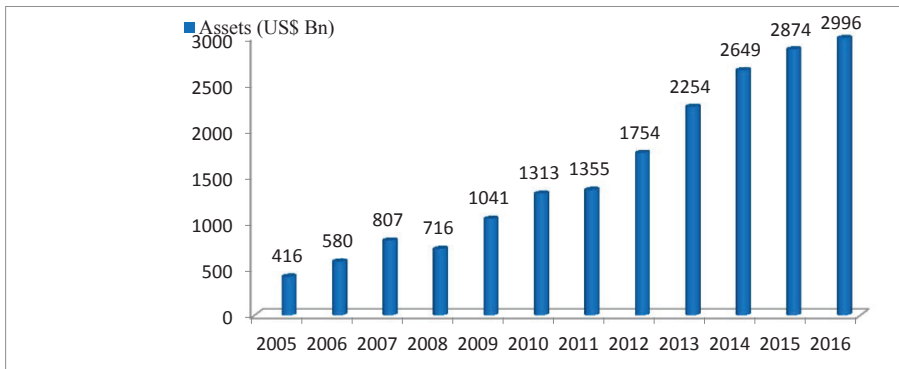
Figure 2 shows how ETF business expanded over the past years. AUM grew over 2,000% Mutual Fund growth comparing to ETF's is dramatically lower. 120% AUM increase over thirteen years can be explained only by much older and stable industry. However, ETFs are becoming serious competitors in such a saturated market.

Figure 2. ETF vs Mutual Fund Growth (Percentage in assets since 2001)

Where does that growing popularity come from? ETF's features, significantly different than earlier investment products provides broad range of advantages over other investment vehicles:

- Accessibility – ETFs finally brought democracy to investment management business. Markets and asset classes reserved only for large institutional investors became easily accessible for individual investors. A sophisticated portfolio can be composed with just an access to a brokerage account.

- Transparency – the most of ETFs are obliged to display their portfolios on a daily basis. ETFs investors unlike mutual funds clients do not have to wonder where their funds have been invested between reporting periods or if a portfolio manager has taken unnecessary risk. Knowing the underlying assets investors may avoid doubling the exposures by holding those assets elsewhere.

- Liquidity – 'Exchange traded' is the key to ETFs extraordinary liquidity. They can be traded multiple times, daily exactly as stocks with transparency and regulatory protection. Also like stocks ETFs can be held with a margin, shorted or optioned. The creation/redemption process allows investors to arbitrage between fund and its underlying securities.

- Tax efficiency – Unlike mutual funds ETFs do not expose their shareholders to capital gains distributions. The redemption in kind ability practically eliminates the need of capital gains distributions.

- Costs – Last but not least, probably the biggest, advantage of ETFs is their expense ratio. Average mutual fund expense ratio is almost 150% higher than average ETF's expense ratio. The savings can be achieved be-

cause ETFs are traded on the stock exchange and most of the costs like recordkeeping or sending the prospectus are borne by brokers.

In summary ETFs set up new investing standards. With lower costs, liquidity, accessibility and tax efficiency they are attracting investors money definitely faster than regular mutual funds. New markets and asset classes became more accessible for smaller investors. In the other hand, big institutional investors received a powerful, liquid tool to be used in their short and long term strategies. What is more, ETFs brought a revolution to classic distribution system accelerating transition to fee based relation between investor and advisor (Hill et al., 2015).

Genesis of index tracking funds

Index tracking ETFs are considered a passively managed investment vehicles. Hearing such statement question arises: What does passive management mean? Index tracking ETFs are mirroring the chosen index by holding assets in exact proportion as an underlying index does. Going further: why does the index hold more certain assets than the other? To answer that we have to go back to the 1950s when Modern Portfolio Theory was introduced by H. Markowitz and to 1960s when W. Sharpe enriched Markowitz's theory by implementing CAPM model. According to Markowitz an investor can construct an effective portfolio that can maximize the returns bearing given level of risk and otherwise certain return can be achieved by bearing minimum risk. According to MPT when assets in the portfolio are positively correlated with each other, the portfolio's variance increases and decreases when assets are negatively correlated. In other words, investor can reduce risk exposure by portfolio diversification, considering also correlation across the assets (Markowitz, 1952). MPT was a sole basis to W. Sharpe CAPM theory which distinguished systematic from specific risk. The systematic risk is a risk of the market and is borne by all the market investors. While the specific risk inhere only a specific security or a group of securities. According to Sharpe, while systematic risk is unavoidable, specific risk can be reduced by proper diversification. The only portfolio free of specific risk is market portfolio, which is a portfolio consisting of a weighted sum of every asset, weighted in proportion to its total presence in the market. CAPM theory also introduced Beta – a measure that indicates asset's volatility comparing to the market (Sharpe, 1966). CAPM model is a single factor model where the only factor influencing asset return is its correlation with market

return. Beta factor can be applied not only to the assets but also to the portfolio. If Beta=1, a risk of the portfolio is equal a risk of market portfolio. Higher Beta portfolios potentially bring higher returns than the market, but risk exposure is also higher than the market risk. In other words, according to the CAPM theory investing in other than market portfolio would expose investor to unrewarded risk (Jajuga, 2004). In early 1970s B. Malkiel in his recognized book 'A Random Walk Down Wall Street' (Malkiel, 2011) also claimed that, buying the market is better that picking individual stocks. Circle of CAPM theory enthusiasts grew rapidly in the 1970s and the first cap-weighted index mutual fund was introduced in 1975 by Vanguard Group (Hill et al., 2015).

SHORTCOMINGS OF CAP-WEIGHTED INDEXING

40 years after introduction of cap-weighted indexing, it is no longer clear that this is the only one legitimate choice of portfolio creation. Cap–weighting would be great solution for efficient markets. Obviously markets are inefficient, so holding a portfolio of stocks weighted proportionally to their capitalization will end with overweighting the overpriced stocks and underweighting the underpriced stocks (Arnott et al., 2010). Literature describes two potential draw backs concerning cap-weighted indices: tilt to potential unrewarded risk factors and potential lack of diversification. Market indices tend to tilt their exposure towards stocks with the largest capitalization and growth stocks (Autier et al., 2016). Regarding to Fama and French exact opposite portfolio is more eager to outperforme the market. Portfolio tilted more towards small capitalization and value stocks (Fama & French, 1993). To minimize the risk investors are looking for well diversified portfolios. What is interesting, cap-weighted indices, which are considered as diversified, are indeed concentrated on the largest companies and most of their holdings are stocks with a largest capitalization. Above mentioned shortcomings are obviously the reason why alternative weighing schemes were developed.

QUANTITATIVE INVESTING – THE RISE OF SMART BETA

Since 1923 when Standard & Poor's introduced firs cap-weighted index, those indices have dominated the equity market. Indices became an integral part of long term investing strategies and are commonly used by individual as well as institutional investors. Choosing a right index became a crucial part of invest-

ment process. In view of shortcomings of cap-weighted indices and growing need for investment vehicles to be more flexible and reflects current investor point of view, alternative weighting schemes have been constructed. Nowadays, investors have a wide range of many different schemes to choose from. Each of them has different objectives, but all have two advantages in common: transparency and attractive risk/reward ratio (Amenc et al., 2010). Constructing an index require two fundamental questions to be answered: Which stocks should be included? and Which weighting scheme should be used? When number and kind of stocks is defined, there is a time to decide which scheme will be suitable for chosen stocks. Unlike CAPM, which both those question would answer with market capitalization, alternative methodologies consider:

- different allocation techniques,
- additional risk premium,
- exposure to undervalued assets,
- use of other than buy and hold strategies (Amenc et al., 2008).

The strategy that differs from the traditional market capitalization index weighting is Smart Beta. What exactly is Smart Beta? Recently the literature defines it various. Definitely, two of them are worth to quote. First one, used by BlackRock: "Smart Beta seeks to improve returns, reduce risks and enhance diversification for investors by delivering exposure to systematic investment factors. By combining characteristics of both passive and active investing, smart beta strategies allow investors to retain many benefits of passive strategies while seeking improved returns or reduced risk. Smart beta is not simply a fund or strategy—it's a different way of thinking about investing beyond traditional active and passive management" (Shores, 2015). Second definition, more reserved about the new weighting methodology by Malkiel: "What most people who use the term have in mind is that it may be possible to gain excess (greater than market) returns by using a variety of relatively passive investment strategies that involve no more risk than would be assumed by investing in a low-cost Total Stock Market index fund" (Malkiel, 2015). Smart Beta definitely revolutionized asset management business. Over last couple years Smart Beta ETFs experienced an epic rise in AUM and investor's attention. Nowadays Smart Beta is booming, but the whole concept isn't new. Fama, French and also Carhart examined certain factor's impact on portfolio return. Themes like value and quality have been used by active managers for many years. If Smart Beta is not entirely new concept, why the sudden rise? For the last decade investors appreciated transparency, simplicity and low fees of passively managed strat-

egies. The progress of technology made fundamental data available and accurate. Thanks to more accessible information and adoption of innovations, the historical data can be systematized, analyzed and many relations may be redefined. What is more, disregarding all the advantages of passive strategies, investors always have been looking to outperforme the market. Recently with a support of technology and quantitative methods it might become possible. Those trends mostly influenced such a rapid emerge of Smart Beta strategies (Shores, 2015).

Implementation of alternative weighting schemes to polish WIG20 index

Alternative index weighting is a highly emotional topic lately. Considering how interesting and controversial the subject is, it's definitely worth to present alternative solutions. In this section the author chose four most popular alternative weighting schemes, gave detailed description, emphasized their advantages and flaws. The best way to demonstrate the changes in the weights brought by each scheme it's to use an as example already existing index. To simplify and bring out distinctive features of each indexing methodology, the author chose, as an example, polish equity index WIG20, which is calculated by GPW since 1994. It's based on the values of 20 most liquid companies with the biggest capitalization.

Equal weighting

The equal weigh approach is one of the first alternative schemes. It is simply based on equal distribution of weights among the assets. It doesn't use any information disclosed publicly or privately to prefer one company over the others. Equal weighting is founded over assumption that, it is impossible to predict risk and return of the assets, so holding an equal amount of each security in the portfolio brigs the lowest risk. This scheme definitely is avoiding one of the biggest shortcomings of cap-weighted indices – overweighting overpriced companies and underweighting undervalued. Underweighting or overweighting assets is no longer systematic, it became random. What is more, equal weights gave rise to immunity to estimation error and provide automatic diversification. Unlike market capitalization, this approach tilts more towards small cap, because it holds small companies on the same scale as the largest. It may be an advantage,

Figure 3. WIG20. Cap vs. equal weighting
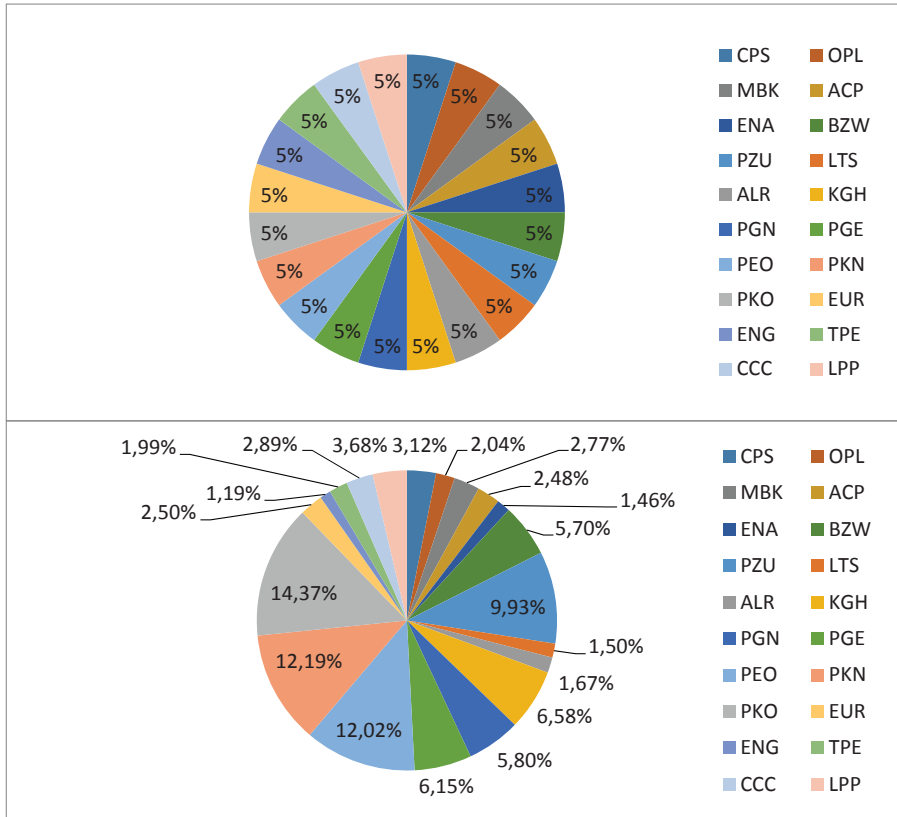
but on the other hand transaction costs are much higher, because EW portfolio needs to be rebalanced very often. Of course lower liquidity of smallest companies should be taken into consideration, which may make frequent rebalancing quite challenging. What might be frustrating for some investors is a necessity to sell well performing assets and buy underperforming, during rebalancing process (Arnott et al., 2010). Figure 3 shows cap-weighted index WIG20, where almost 50% of index capitalization is concentrated in four major assets: PZU, PKO, PEO, PKN. What is more, three out of four companies represents financial sector. Going further, the return and the risk of the portfolio depends on performance of those four companies. Holding an index portfolio like WIG20 investor's profit or loss depends mostly on condition and trends of only one sector.

In the light of above considerations, the question arises: Is the performance of those four stocks worth taking such a substantial risk? In this particular case, considering quite a short term, twelve months average return rate of WIG20 components, the answer is no, because only one of those four companies – PKO brought a slight return. On the other hand, underweighted stocks like EUR or CPS brought a significant return. As can be seen on figure below, equal weighting index eliminates the problem of underweighting undervalued stocks. The weights are distributed equally among the assets, so is the risk.

Table 1 compares annual return from cap-weighted and equal weighted WIG20 portfolio. The rebalancing of the portfolio has been eliminated to avoid unnecessary calculations. That is the reason why return rates haven't been compared in the longer term than a year. In a longer run exclusion of the rebalancing process is not an option, because without frequent rebalancing of the portfolio weights would become far from equal. Concluding this comparison, equal weighted portfolio is definitely more diversified than cap-weighted. The risk is distributed equally among the component stocks. Comparing annual return rates, it's difficult not to perceive that diversification of the portfolio can significantly decrease the risk. Going further, possible losses caused by major assets devaluation can be reduced. In this particular case by almost 5%.

Table 1. Annual return rate: Cap vs. equal weighted portfolio

	Annual return	Annual return difference over cap-weighting
Cap-weighted WIG20	-16,88%	–
Equal weighted WIG20	-12, 21%	-4,67%

S o u r c e : author's elaboration.

Weighting for maximum Sharpe ratio

According to Modern Portfolio Theory efficiently allocated portfolio, called also the tangency portfolio, is the one with the highest reward/risk ratio. In other words, investors should look for a portfolio with a highest Sharpe ratio, which is defined as:

$SR_p = \frac{\bar{\mu}'\bar{w}-r_0}{\sqrt{w\sum\bar{w}}}$, where:

μ – vector of expected return in excess of risk free rate,
r_0 – risk free rate,
$\sum$ – the covariance matrix for returns of these elements.

Amenc, Goltz and Martellini in the result of the estimation of risk and expected return, proposed the weights optimization formula:

$w^* = \mathrm{argmax_w} \frac{\bar{\mu}'\bar{w}-r_0}{\sqrt{w\sum\bar{w}}}$, where w* – efficient weights.

The goal of this approach is to generate the highest return from a unit of risk and increase return/risk efficiency. Going further, it can be hypothesized, that MSR portfolios will bring a constant return with a stable level of risk. Of course, max Sharpie ratio index needs to be rebalanced in frequent intervals. The question: is how frequent? There are approaches, which recommend quarterly rebalancing. However, managing transaction costs, it is reasonable to rebalance whenever it's needed, disregarding time periods. Amenc recommends to rebalance the weights whenever they will exceed certain, previously set proportions. The researches proves that efficient indexation brings significantly lower tracking error than cap-weighted indices (Amenc et al., 2010). On the other hand, MSR portfolio is based on the assumption, that the return is proportional to risk, what may cause exclusion of low–risk stocks. Generally speaking, efficient indexation brings lower volatility and higher returns that cap-weighted indices. Going back to polish market, Figure 4 compares cap-weighted WIG20 to MSR weighted index based on WIG20 components. It was created by maximizing Sharpie ratio calculated on the ground of monthly return rates of WIG20 companies (data range: 01.2013–07.2016). As the figure shows, only four assets has been chosen to the index. Qualifying any other WIG20 companies would result in lower Sharpie ratio. To increase diversification, adding some constrains, like minimum weights, can be considered, but it will not increase the efficacy. To construct effective index an investor should reach beyond WIG20 and add companies from outside of the largest twenty. Of course, index consisting of only four stocks is not representative and diversified enough. However, it may be a good example, how far from being effective cap-weighted WIG20 is. Sharpie ratio for created portfolio equals 0.35 comparing to – 0.06 for cap-weighted. Equating annual return rates in Table 2 it is easy to see, how MSR weighting

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improved the return rate. Considering above mentioned arguments and calcu-
lations it is obvious that in WIG20 case reaching out for alternative weighting
scheme was definitely beneficiary.

Figure 4. WIG20. Cap vs. MSR weighting
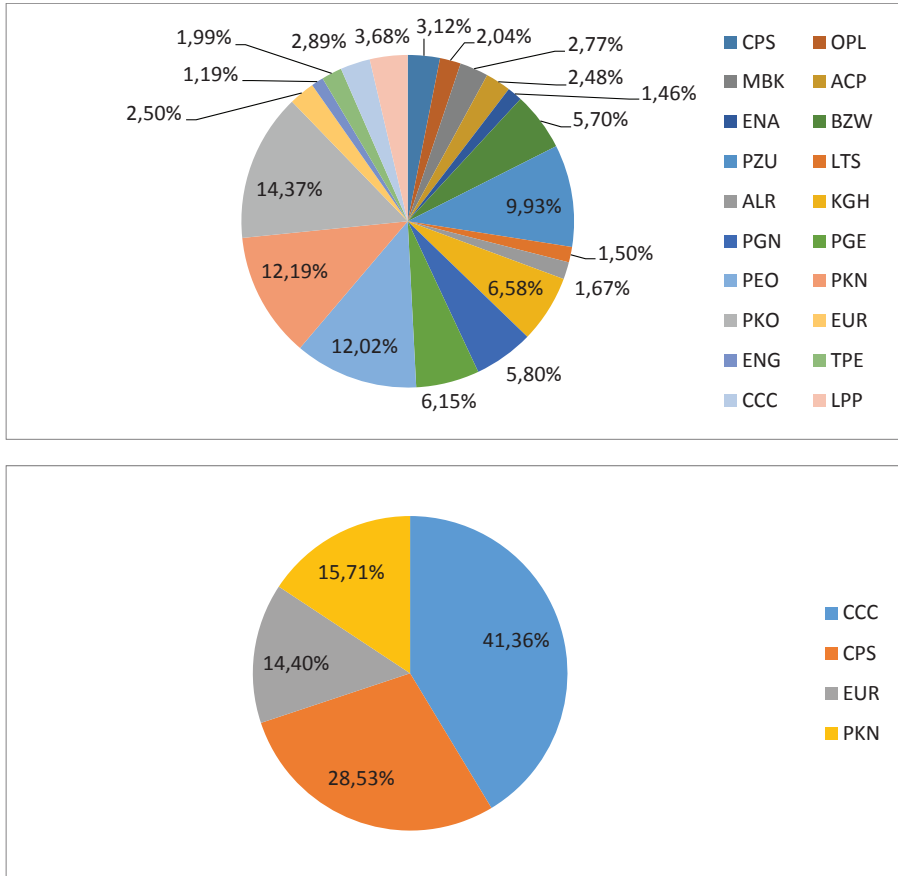
Table 2. Annual return rate: Cap vs. MSR portfolio

	Annual return	Annual return difference over cap-weighting
Cap-weighted WIG20	-16,88%	–
MSR-weighted WIG20	+3,15%	13,73%

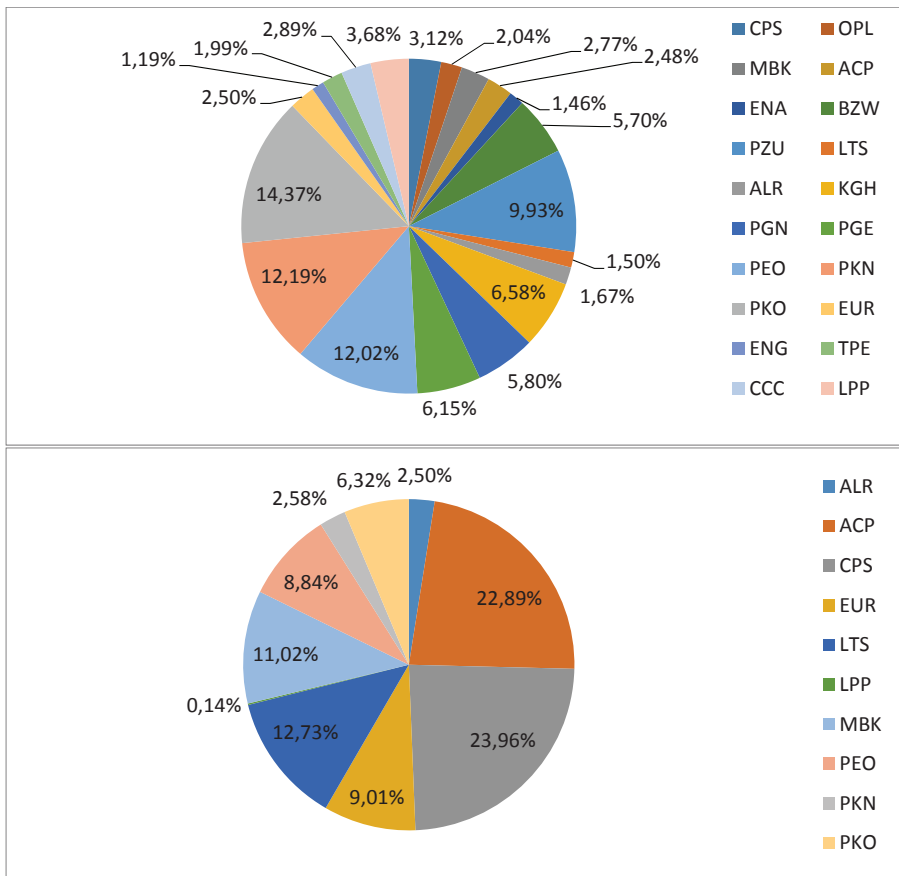S o u r c e : author's elaboration.

GLOBAL MINIMUM VARIANCE

This approach has been introduced in the early 1990s. Global Minimum Variance is designed to reduce portfolio risk and focuses on defining weights that will bring lowest possible portfolio volatility. The goal of GMV is to create high return and adjusting risk at a same time (Arnott et al., 2010). Researches of Ang (Ang et al., 2006) proves that comparing to the market low-volatility assets bring greater returns and high-volatility stocks usually bring lower returns than the market. The same regularity on European and Japanese markets has been identified by Blitz and van Vliet (Blitz & van Vilet, 2007). Construction of GMV index is quite simple. To find the right weights, only the estimation of volatilities and correlation of component assets is needed:

$$w_{GMV} = \frac{\Sigma^{-1}1}{1'\Sigma^{-1}1}$$, where: 1– vector of ones, Σ – covariance matrix.

Studying stock selection, it can be observed that GMV favors low beta stocks. That is the reason why low volatility indexes has the lowest beta of all alternative indices. Of course low volatile assets are an advantage, but focus on least volatile stocks regardless of other factors may bring high concentration in utility sector, which is known of its low volatility (Amenc et al., 2013). At this moment the question arises: If the investors are moving away from cap-weighted indices, because of their high concentration in the largest stocks, is choosing heavily concentrated, but in least volatile stocks a good solution? To diversify the GMV portfolios, improvements like constraining the weights or modifying model's assumption has been proposed. The best known improved GMV approaches are Maximum Decorrelation, which assumes that volatility is the same across the stocks or Diversified Minimum Variance, where has been assumed that there is no correlation between stocks. Figure 5 shows implementation of GMV weighting to WIG20 by minimizing index's variance based on

43 months data. Portfolio is quite diversified. Contains 10 companies. Other 10 have been eliminated due to negative mean return rates. Over 45% of portfolio is concentrated in 2 companies: ACP (IT) and CPS (Media). Both have positive mean return rate and one of the lowest standard deviation. Looking on Table 3, which compares annual return rates between Cap and GMV weighted portfolio, it can be easily noticed how the return rate improved when the weighting scheme has changed.

Figure 5. WIG20. Cap vs. GMV weighting

S o u r c e : author's elaboration.

Table 3. Annual return rate: Cap vs. GMV portfolio

	Annual return	Annual return difference over cap-weighting
Cap-weighted WIG20	-16,88%	-
GMV-weighted WIG20	+5,28%	22,16%

S o u r c e : author's elaboration.

THE OUTCOME OF THE RESEARCH PROCESS AND CONCLUSIONS

The rapid growth of Smart Beta strategies along with democratization of investing brought by ETFs is often perceived as a threat by active asset managers. Cost effective and approachable funds, traded via stock exchange with ability to outperform traditionally weighted indices and sometimes even actively managed funds, revolutionized asset management business. Transparency of ETFs with new, quantitative approach to stocks selection is far from classical asset management. Stocks are not selected by interviewing the management or studying prospectus. Historical data is analyzed to redefine relations between component asset and simple questions are being asked. Fundamental approach wants to know: how big is the company? and How is it doing so far? To answer that analysis of major accounting measures needs to be done. Why any asset should be favored among the others? That is the question asked by equally weighted portfolio, which distributes weights equally among all the component stocks. Minimum variance portfolio is the answer for the question: How to minimize the risk and generate highest possible return? How to optimize risk/reward ratio? That defines Maximum Sharpie Ratio scheme (Arnott et al., 2010). All the four described schemes have different risk/return ratio and different features, like minimum variance favors low beta stocks or fundamental weighting focuses on highest value exposure. Graphical analysis allowed to compare impact of different schemes on WIG20 index. The results of conducted research support the hypothesis. All the four described schemes outperformed WIG20 index. Analysis of empirical data in this paper definitely proved that cap-weighted WIG20 is far from being effective. Exposure to different factors showed how traditional indices can be simply improved and how to eliminate common problems of cap-weighted indices. Each one of four presented alternatives provided a different solution. However, present research proves that implementation of alternative weighting schemes improves the performance of

an index. Drawing the conclusions from this analysis and reaching outside of WIG20, alternative weighting schemes can be a great stock selection tool and with a sufficient data and resources interesting index can be created. Different investors may choose the alternative with features they value the most or combine the schemes to access exposure to the desired factors in the right proportions. Smart Beta strategies might be also beneficial to active managers, who can use different, alternative approaches as building blocks to actively allocate risk and get desired factor tilts. Alternatives are still a hot topic and considering the eternal battle between passive and active investing, the truth may lie in the middle. For over fifty years we all have been looking for alphas. Now may be the time to stop chasing alphas and focus on improving the betas.

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