

2 Principles of Portfolio Management Conditions

2.1 Economical Denotation of Indices

The quantity of stock indices depends on different indexing approaches¹⁰⁸, which escalates analogous to the increasing number of listed companies.¹⁰⁹ Diverse index providers¹¹⁰ calculate their indices by different rules. The composition and the exchange of index members have to be distinguished as well as their weightings and the treatment of issued rights, dividends and nonstandard payouts¹¹¹. The range is extended by issuers of securities that use their probability to create idiosyncratic indices¹¹². In this process an exact, transparent and traceable definition of the composition parameters has to be published for every investor.¹¹³ These own creations are – in contrast to market barometers of pure index providers – only infrequently licensed or resold and feature fewer acceptances by market participants.¹¹⁴

Stock indices represent the focus of the economical and especially the exchange business¹¹⁵ displaying security market developments.¹¹⁶ Market fragments like industries or sectors¹¹⁷ can be separated and examined with the help of sub indices.¹¹⁸

The global environment of indices changes as fast as the economies, regulatory conditions¹¹⁹, analyst forecasts, appearances of capital market crunches¹²⁰ and technological circumstances do.¹²¹ For this reason governmental influences have modified the universal stock index trading during the last years several times and this continuous process will pursue in the future.¹²² Since investors have appreciated that they are exposed by an additional portion of risk because of future uncertainty, they attach greater importance to their asset, risk and liability management.¹²³ Hence, indexing is and will remain a meaningful subject within the management process of security portfolios.¹²⁴

¹⁰⁸ Cp. Ganser (2008), p. 15.

¹⁰⁹ Cp. Rühle (1991), p. 1.

¹¹⁰ Cp. Sultan, Hasan (2008), p. 469.

¹¹¹ Cp. Schmitz-Esser (2000), p. 147ff.

¹¹² Cp. HSBC Trinkaus [ed.] (2008), p. 1ff.; Commerzbank [ed.] (2008), p. 33.

¹¹³ Cp. Curtillet, Dieudonné (2007), p. 404.

¹¹⁴ Cp. Wohlenberg, Brockmann, Grass (2006), p. 731.

¹¹⁵ Cp. Sebastião (2010), p. 612.

¹¹⁶ Cp. Andreou, Pierides (2008), p. 212.

¹¹⁷ Cp. Zwick, Collins (2002), p. 66.

¹¹⁸ Cp. Patra, Poshakwale (2008), p. 1401.

¹¹⁹ Cp. Tropeano (2011), p. 46.

¹²⁰ Cp. Linsmeier (2011), p. 411ff.

¹²¹ Cp. Birkner (2010), p. 24ff.; McFarlin (2011), p. 24.

¹²² Cp. Yang, Gondzio (2010), p. 74.

¹²³ Cp. Yang, Lai (2009), p. 1059; Lin, Yeh (2009), p. 1965.

¹²⁴ Cp. Branch, Cai (2011), p. 64.

2.1.1 Functions of Indices in the Portfolio Management

Functions of indices prevail for every index provider and clarify the denotation of indices in the context of entire portfolios.¹²⁵ The ordinary asset management is subject to diverse assumptions that are analysed¹²⁶ and interpreted by indices.¹²⁷

Due to individual marketing strategies and competition a different acquaintance of these functions prevails amongst index providers¹²⁸. During the last years several companies eliminated the gratuitous and public excess to their data. For this reason a replication of indices is just possible with constrictions. Since April 01st 2010 the STOXX Ltd. exclusively releases the index members without their respective weightings. Institutions intending to achieve admission to entire data have to sign a sumptuous license agreement.¹²⁹

2.1.1.1 Benchmark Function

The benchmark function or levelling rule describes the index as dimension of comparison for actively managed portfolios.¹³⁰ The active portfolio strategy aims for an outperformance¹³¹ according to its benchmark.¹³² For the evaluation of the management success the portfolio is compared to a representative cross selection of the market whereat the basic populations of both portfolios have to exhibit the identical level of risk.¹³³ Otherwise risk adjustments¹³⁴ have to be conducted.¹³⁵

The choice of an appropriate benchmark executes an eminent influence to the investor's behaviour because it arranges the general investment framework.¹³⁶ In consideration of the benchmark function, the index ministers to monitor the market segment, the performance evaluation, the determination of a suitable asset allocation as well as the implementation of any investment decisions and risk adjustments.¹³⁷

¹²⁵ Cp. Amenc, Goltz, Martellini (2011), p. 11; Saritas, Aygoren (2005), p. 1299.

¹²⁶ Cp. Kugler, Henn-Overbeck, Zimmermann (2010), p. 356.

¹²⁷ Cp. Wüthrich (2010), p. 21.

¹²⁸ Cp. Barney (2010), p. 1ff.

¹²⁹ Cp. STOXX Ltd. [ed.] (2011a).

¹³⁰ Cp. Amenc, Goltz, Martellini (2011), p. 11; Bogle (2005), p. 114f.

¹³¹ Cp. Achleitner, Kaserer, Moldenhauer (2005), p. 121.

¹³² Cp. Rohweder (1992), p. 23; Melas, Kang (2010), p. 10; Klement (2011), p. 50f.

¹³³ Cp. Krein (2010), p. 20; Costa, Jakob (2010), p. 95.

¹³⁴ Cp. Rompolis, Tzavalis (2010), p. 129ff.

¹³⁵ Cp. Elton, Gruber, Busse (2004), p. 272; Madhavan, Ming (2003), p. 35.

¹³⁶ Cp. Schoenfelder (2004), p. 59f.; Wüthrich (2010), p. 63f.

¹³⁷ Cp. Cloyd, Siegel, Schoenfelder (2004), p. 63ff.

The mediation has to be distinguished *ex ante* into the asset allocation and *ex post* into the relative performance evaluation¹³⁸. To fulfil this function an index has to feature preferably humble transaction costs¹³⁹, exist enduringly, offer a broad diversification and consequently only fractions of systematic risk as well as assimilable restrictions like the investor's portfolio.¹⁴⁰ These kinds of allocation principles have to be acquainted by the investor before determining the appropriate benchmark index.¹⁴¹ If these specifications are not met, the objectivity and the acquirement of the portfolio manager could be challenged.¹⁴²

Investment funds and investment management portfolios are even subject to regulative covenants declaring an eligible benchmark¹⁴³. Thereby standardised or individually constructed indices can be adducted, though the second may doubt the requirements of transparency and replication abilities as well as regulative parameters.¹⁴⁴

2.1.1.2 Information Function

Indices aggregate a multitude of members with homogeneous characteristics in a single, average measure¹⁴⁵ and document the alteration of the asset values during a variation in time.¹⁴⁶ Co-instantaneously this changeableness describes an essential function of indices, in fact the documentation of information in the shape of fluctuating conditions.¹⁴⁷ Individual information of the index members is cumulated in the progressionally¹⁴⁸ calculated price of the index¹⁴⁹.

In the specification of the information function indices serve as the aggregated informational mediums for a cost-efficient¹⁵⁰ preparation of disclosure.¹⁵¹ In addition to the value of the index further information like the average dividend yields, price earnings ratios¹⁵² and economical measures can be obtained by the use of statistical parameters.¹⁵³

¹³⁸ Cp. Guojin, Li, Shin (2011), p. 1012.

¹³⁹ Cp. Martins-da-Rocha, Vailakis (2010), p. 66.

¹⁴⁰ Cp. Etterer, Beer, Fleischer (2003), p. 116ff.; Stucki (1996), p. 182; Sharpe (1992), p. 16.

¹⁴¹ Cp. Curtillet, Dieudonné (2007), p. 404.

¹⁴² Cp. Roll (1977), p. 129; Christopherson (1998), p. 93; Maguire, Karaban, S&P [ed.] (2009), p. 4.

¹⁴³ Cp. Rose (2005), p. 21.

¹⁴⁴ Cp. Fong, Gallagher, Lee (2008), p. 762.

¹⁴⁵ Cp. Amenc, Goltz, Martellini (2011), p. 11.

¹⁴⁶ Cp. Bley Müller, Gehlert, Gülicher (2008), p. 181; Ganser (2008), p. 15.

¹⁴⁷ Cp. Demchuk, Gibson (2006), p. 867.

¹⁴⁸ Cp. Schmitz-Esser (2001), p. 19.

¹⁴⁹ Cp. Bley Müller (1966), p. 15.

¹⁵⁰ Cp. Kaserer, Achleitner, Moldenhauer, Ampenberger (2006), p. 12.

¹⁵¹ Cp. Vespro (2006), p. 126; Lee, Chien, Liao (2009), p. 828.

¹⁵² Cp. Bhargava, Malhotra (2006), p. 87ff.

¹⁵³ Cp. Marquering, Verbeek (2004), p. 407.

This kind of accumulation is *inter alia* influenced by factors like investor's hope and fear as well as wars and prospective economical developments.¹⁵⁴ Indices equal statistical measures¹⁵⁵ exhibiting investor's expectance of future trends, whereupon the celerity of market reactions has been enhanced due to the mobile data transfers.¹⁵⁶

The central audience tracking individual intentions assembled by the information function is arranged by media, publicity, analysts and investors. Technical¹⁵⁷ signals can be discharged by consolidated information representing the foundation of prospective forecasts¹⁵⁸ and trading decisions.¹⁵⁹

The entire stock market and the results of the specified information occupied from the ex post index analysis, serving as sufficient resource for several ex ante estimations¹⁶⁰ and the consequent allocations of funds by financial advisors and investors¹⁶¹.

2.1.1.3 Underlying Function

In the context of the Portfolio Selection Theory and especially the efficient market hypothesis a stock index displays the risk-adjusted and diversified market portfolio within a special framework of composition standards.¹⁶² The original admission into an index equals a fictitious investment into the consolidated underlying securities at the effective date t_0 .¹⁶³ By an accommodation of about 20 to 25 stocks, a fundamental decrease of the diversifiable unsystematic risks has been accomplished as far as possible. The greater the number of index members, the more realistic is the approach to display the essential total market by the index portfolio.¹⁶⁴ The efficiency of the market return's variance and unbiased estimator is enhanced by diversification.¹⁶⁵ With a completely utilised diversification level of the benchmark an active portfolio manager is unable to achieve an outperformance by widening the portfolio risks in contrast to the reference index.¹⁶⁶ A potential improvement¹⁶⁷ is exclusively possible by the stock selection, weighting and timing aspects.¹⁶⁸

¹⁵⁴ For further information of investor's behaviour; cp. Muga, Santamaria (2007), p. 637ff.

¹⁵⁵ Cp. Cloyd, Siegel, Schoenfelder (2004), p. 65f.; Barbosa (2009), p. 37.

¹⁵⁶ Cp. Sosvilla-Rivero, Rodriguez (2010), p. 2081f.

¹⁵⁷ Cp. Kurz (2010), p. 1184.

¹⁵⁸ Cp. Dueker, Assenmacher-Wesche (2010), p. 2910ff.

¹⁵⁹ Cp. Wohlenberg, Brockmann, Grass (2006), p. 730f.; Bodie, Kane, Marcus (2005), p. 258ff.

¹⁶⁰ Cp. Pilinkus (2010), p. 291f.

¹⁶¹ Cp. Winchester, Huston, Finke (2011), p. 43.

¹⁶² Cp. Vespro (2006), p. 126.

¹⁶³ Cp. Ganser (2008), p. 16.

¹⁶⁴ Cp. Schmitz-Esser (2001), p. 103; Bleymüller (1966), p. 21.

¹⁶⁵ Cp. Kim, Cho, Mandziuk, Jaruszewicz (2011), p. 95ff.

¹⁶⁶ Cp. Griese, Kempf (2003), p. 210ff.; Duan, Hu, McLean (2009), p. 56ff.

¹⁶⁷ Cp. Poddig, Brinkmann, Seiler (2009), p. 305.

¹⁶⁸ Cp. Brealey, Myers, Marcus (2007), p. 284f.; Bamberg, Baur (1996), p. 148.

Because of the relatively distinct information efficiency of modern capital markets, the contingency of an outperformance by active management is just conditionally feasible.¹⁶⁹ With the help of indexing merely an optimisation of investor's costs and accompanied declining trading activities are conducted.¹⁷⁰ In this characteristic indices officiate for testing market efficiency and predicting future returns.¹⁷¹

Within the underlying function the index composes the base value for (derivative) financial products¹⁷² such as index futures¹⁷³, options, certificates, warrants or funds and respectively Exchange Traded Funds (ETFs).¹⁷⁴ The index is thereby tradable in one single security.¹⁷⁵

The establishment of index funds and ETFs¹⁷⁶ caused a further enhancement of transparency and cost-efficiency for investors and desired a more valid contest for actively managed portfolios.¹⁷⁷ Comparing the total expense ratios (TER) of actively managed funds and ETFs illustrates this advantage. An average active fund's TER is at about 1,4% and most ETF's expenses are not half as exalted.¹⁷⁸ The growing importance of ETFs according to equity index benchmarks has increased during the last years accompanied by an expansion of general stock market trading activities.¹⁷⁹ The inserted liquidity and increased market efficiency¹⁸⁰ makes it more comfortable for investors to act in regulated markets with conspicuously constricted possibilities of manipulation.¹⁸¹

The index and its members build a guideline displaying a passive investment strategy.¹⁸² In contrast to active allocation decisions it is not attempted to create an outperformance towards the benchmark.¹⁸³ Index tracking¹⁸⁴ tends to avoid mean returns compared to the market.¹⁸⁵ The first index investments were documented during the 1970s in the USA. In Europe indexing faces an important role since the end of the 20th century.¹⁸⁶

¹⁶⁹ Cp. Blitz, van Vliet (2008), p. 23ff.

¹⁷⁰ Cp. Kat (2002), p. 1.

¹⁷¹ Cp. Patra, Poshakwale (2008), p. 1409.

¹⁷² Cp. Booth, So (2003), p. 488.

¹⁷³ Cp. Gwilym, Buckle (2001), p. 385ff.

¹⁷⁴ Cp. Amenc, Goltz, Martellini (2011), p. 11.

¹⁷⁵ Cp. Kaserer, Achleitner, Moldenhauer, Ampenberger (2006), p. 12.

¹⁷⁶ Cp. Korn (2007), p. 72.

¹⁷⁷ Cp. Cloyd, Siegel, Schoenfelder (2004), p. 72f.; Hseu, Chung, Sun (2007), p. 216.

¹⁷⁸ Cp. Landis (2008), p. 50.

¹⁷⁹ Cp. Milonas, Rompotis (2010), p. 97.

¹⁸⁰ Cp. Lim (2009), p. 1129.

¹⁸¹ Cp. Kim, Park (2010), p. 296f.

¹⁸² Cp. Bruns, Meyer-Bullerdiek (2001), p. 104ff.

¹⁸³ Cp. Rompotis (2009), p. 263.

¹⁸⁴ Cp. Frino, Gallagher, Neubert, Oetomo (2004), p. 89.

¹⁸⁵ Cp. DeFusco, Ivanov, Karels (2011), p. 182.

¹⁸⁶ Cp. Black, Scholes (1974), p. 637ff.; Wagner, Diller, Brück (2005), p. 56.

The replication of an index is never perfectly possible due to accruing costs, but tracking can be simplified by declaring special allocation criteria.¹⁸⁷ While arranging the tracking strategy¹⁸⁸ it has to be determined if a full replication¹⁸⁹ or an optimisation strategy is preceded. The replication assumes investments into the identically weighted assets. Opponently the optimisation strategy is an approximate reproduction of the index by securities or derivatives¹⁹⁰ that feature assimilable returns as the index members. This amplifies the hazard of increasing tracking errors.¹⁹¹

Tracking products connect the advantages of risk diffusion by different assets with comparable transaction costs¹⁹². Hence, a replication is possible, if the index calculation and reporting is transparent and the securities are liquidly tradable.¹⁹³

The arising costs are subject to the respective index construction. The higher the degree of index diversification is, the superior are the transaction costs of the tracking process, whereby a trade off arises.¹⁹⁴ Regularly transaction costs are not constant because they depend on the scale of trading activities¹⁹⁵. Every decision to reallocate¹⁹⁶ the portfolio should therefore create an excess value that exceeds the arising costs to keep the tracking error as marginal as possible¹⁹⁷. Amongst others these costs combine the management fees, premiums, bid ask spreads and the market impact¹⁹⁸. The latter composes the most conspicuous effect to the total costs.¹⁹⁹

2.1.2 Differentiation of Indexing Concepts

A general principle of stock index calculation does not exist. Rather varying approaches can be distinguished.²⁰⁰ Each index formula defines the measurement of the index level combining the member's prices and their weightings.²⁰¹ A further impact depends on the acquaintance of market extrinsic price changes like for example payouts.²⁰²

¹⁸⁷ Cp. Grobys (2009), p. 11f.

¹⁸⁸ Cp. Frino, Gallagher, Oetomo (2005), p. 24.

¹⁸⁹ Cp. Melas, Suryanarayanan, Cavaglia (2010), p. 39.

¹⁹⁰ Cp. Trivellato (2009), p. 5.

¹⁹¹ The tracking error describes the statistical deviation of the (passive) indexing strategy from the underlying index; cp. Barbosa (2009), p. 39.

¹⁹² Cp. Jang, Koo, Liu, Loewenstein (2007), p. 2329ff.

¹⁹³ Cp. Wohlenberg, Brockmann, Grass (2006), p. 731.

¹⁹⁴ Cp. Yu, Yang, Wong (2007), p. 135; Griese, Kempf (2003), p. 203; Lovell, Arnott (1989), p. 2.

¹⁹⁵ Cp. Hasebrouck (2009), p. 1475.

¹⁹⁶ Cp. Atkinson, Storey (2010), p. 323.

¹⁹⁷ Cp. Haslem (2009), p. 58.

¹⁹⁸ Cp. Bikker, Spierdijk, van der Sluis (2010), p. 369ff.

¹⁹⁹ Cp. Jones, Stine (2010), p. 416.

²⁰⁰ Cp. Ganser (2008), p. 15.

²⁰¹ Cp. Budinsky (2002), p. 216.

²⁰² Cp. Schmitz-Esser (2000), p. 147ff.

The technical requirement of reliability considers the quality of data, the continuity, the consistency and the latitude of manipulation. These elementary factors describe the crucial coefficients that have to be maintained by index providers to be accepted by potential customers and investors.²⁰³ Globally numerous index investments are calculated and traded continuously.²⁰⁴ Prospectively their importance will rise and further concepts will be developed.²⁰⁵

2.1.2.1 Price Index

Price indices are calculated by a fixed number of stocks and display the index level by their quantified developments.²⁰⁶ In contrast to investments in the underlying stocks, price indices do not take dividend payouts²⁰⁷ or executed corporate actions of member companies into consideration.²⁰⁸ At the payout date the index level will *ceteris paribus* decline by the exact amount that is distributed to the shareholders, adjusted by the respective weighting impact.²⁰⁹ Hence, price index levels are exclusively influenced by changes in the demand and supply chains of the member stocks without regarding the respective interim pay-outs.²¹⁰

Exemplary price indices are the STOXX index family, the Standard & Poor's (S&P) 500 and the Swiss Market Index (SMI).²¹¹

2.1.2.2 Performance Index

In contrast to price indices, the calculation of a performance index²¹² incorporates all kinds of payouts and corporate actions.²¹³ Dividends, premiums and special payments are instantly reinvested in the concerning stock and implied into the index calculation.²¹⁴ This reinvestment takes place analogous to the index weighting of the respective company. The induction occurs either by the gross²¹⁵ or the cash dividend²¹⁶ whereat the gross amount equals the cash payment adjusted by the corporate tax rate²¹⁷.

²⁰³ Cp. Schmitz-Esser (2001), p. 107ff.; FTSE [ed.] (1996), p. 6; FTSE [ed.] (1999), p. 2.

²⁰⁴ Cp. Murguia, Umemoto (2006), p. 73.

²⁰⁵ Cp. Etterer, Beer, Fleischer (2003), p. 121.

²⁰⁶ Cp. Rühle (1991), p. 86; Deutsche Börse AG [ed.] (2008), p. 29.

²⁰⁷ Cp. Ganser (2008), p. 26.

²⁰⁸ Cp. Schlienkamp, Frei (1997), p. 69; Grill, Perczynski (2008), p. 270; Jobst (1997), p. 21.

²⁰⁹ Cp. Commerzbank AG [ed.] (2008), p. 35.

²¹⁰ Cp. Chen, Noronha, Singal (2004), p. 1928.

²¹¹ Cp. Spremann, Gantenbein (2005), p. 180.

²¹² The items performance and total return index are used synonymously; cp. Herrmann (1997), p. 1.

²¹³ Cp. Jobst (1997), p. 21; Schusteritsch, Niederl (2007), p. 8; Schröder, ZEW [ed.] (2005), p. 6.

²¹⁴ Cp. Garobbio (1995), p. 21.

²¹⁵ Cp. Hodgkinson, Holland, Jackson (2006), p. 245.

²¹⁶ Cp. Yilmaz, Gulay (2006), p. 20.

²¹⁷ Cp. James, Mohideen (2011), p. 46.

Hence, the investor's individual fiscal aspects remain unconsidered. The index calculation by the inclusion of a cash payout presumes the tax rate of the stock holder as identical to the corporate tax rate of the company.²¹⁸

The German DAX is one of the most common and accepted performance indices.²¹⁹

2.1.3 Consideration of Index Weighting Concepts

The most prevalent comprehension of indexing addresses the weighting by market capitalisation (cap).²²⁰ Further indexing approaches exist, which exemplary deal with enhanced or fundamental and active indexing techniques.²²¹

2.1.3.1 Price Weighting

Price weighted stock indices represent an average summation of the single member's prices. They do not represent an index in the common sense but rather a moving average²²². During the calculation at time t all members prices p_{it} are added and divided by the total number of members n . Formula (1) illustrates the index formula with the quality factor $1/c$.²²³ This factor ensures the index continuity and considers stock splits or the disbursement of bonus shares²²⁴. The fraction of company's shares would decrease without a change in the market value of the company.²²⁵ The calculation on the effective day occurs with the use of the new divisor and the altered stock price. It adds the same index level as prior to the corporate action.²²⁶

$$(1) \quad I(t) = \frac{1}{c} * \frac{\sum_{i=1}^n p_{it}}{n}.$$

Corresponding to the previous explanations the calculation of an index presupposes the comparison of the current value with the moment t_0 when the base investment was executed.²²⁷ This reference is missing in formula (1) which has to be conducted per dividing the term by the base level at t_0 , addicted with the help of formula (2).²²⁸

²¹⁸ Cp. Wetzel (2000), p. 20.

²¹⁹ Cp. Etterer, Beer, Fleischer (2003), p. 123.

²²⁰ Cp. Branch, Cai (2011), p. 65.

²²¹ Cp. Orgland, Leveau (2008), p. 24.

²²² Cp. Field (2010), p. 34.

²²³ Cp. Ganser (2008), p. 20ff.; Bodie, Kane, Marcus (2005), p. 49.

²²⁴ Cp. Karamjeet, Balwinder (2010), p. 49.

²²⁵ Cp. Wetzel (2000), p. 11f..

²²⁶ Cp. Rühle (1991), p. 35.

²²⁷ Cp. Ganser (2008), p. 16.

²²⁸ Cp. Schmitz-Esser (2001), p. 147.

$$(2) \quad I_0 = \sum_{i=1}^n p_{i0}.$$

The Dow Jones (DJ) Industrial Average and the Nikkei 225 are currently the only existing important price weighted stock indices.²²⁹

The calculation is subject to the disadvantage of weighting every index member independently from its relative denotation with a disproportionate quantity. Hence, the explanatory power of the index expansion for the total market development is only restrictedly representative.²³⁰ The index movement is dominated by severe members which is objectively not justifiable.²³¹

Stock price movements of the members have got a price²³² and a size effect²³³. A surpassingly rising stock price provokes a duplicated effect to the index: On the one hand the stock price rises and on the other the relative weighting of the company's shares ascends in the index. Because of this reason a rising price of small (major) index member is overestimated (underestimated) in proportion to the total market.²³⁴

The DJ Industrial Average could establish because the absolute price standard of the stocks traded at the New York Stock Exchange (NYSE) mainly resides in the interval between 20 and 100 USD. If a stock price exceeds the upper level, a split is generally conducted and the price is relocated into the primary interval. Hence, the influence of the implicit price weighting is therefore restricted by a downward bias.²³⁵

2.1.3.2 Equal Weighting

Within equally weighted stock indices²³⁶ every member exhibits the identical effect on the index development.²³⁷ Thereby the arithmetical and the geometrical calculation of an equal weighting²³⁸ have to be distinguished.²³⁹ The calculation of a geometrical price average occurs with the help of formula (3):²⁴⁰

²²⁹ Cp. Elton, Gruber, Brown, Goetzmann (2007), p. 21f.

²³⁰ Cp. Spremann, Gantenbein (2005), p.180f.

²³¹ Cp. Bley Müller (1966), p. 59; Deininger (2005), p. 1.

²³² Cp. Duchin, Levy (2010), p. 625.

²³³ Cp. Penman, Richardson, Tuna (2007), p. 435.

²³⁴ Cp. Wetzel (2000), p. 12f.

²³⁵ Cp. Schmitz-Esser (2001), p. 147f.

²³⁶ Cp. Cohen (2003), p. 40.

²³⁷ Cp. Velvadapu (2011), p. 23.

²³⁸ Cp. Hamza, Kortas, L'Her, Roberge (2007), p. 103.

²³⁹ Cp. Jobst (1997), p. 21; Commerzbank AG [ed.] (2008), p. 38f.

²⁴⁰ Cp. Schmitz-Esser (2001), p. 148.

$$(3) \quad I_{t0}^{Ge} = \frac{\sqrt[n]{\prod_{i=1}^n P_{it}}}{\sqrt[n]{\prod_{i=1}^n P_{i0}}}.$$

The geometrical calculation is subject to two disadvantages: Firstly every stock perceives the same weight. An index tracker has to absorb enormous costs of reallocation²⁴¹ to invest the same amounts into the member securities over time. Successful stocks have to be sold and the disengaged amount is reinvested into the decreased stocks to rebalance their weight.²⁴² The investor is unavoidably following an anti-cyclical investment strategy.²⁴³ Secondly a further disadvantage develops by the systematic undervaluation of price changes. A geometrical price average is always lower than its arithmetical counterpart. The relative changes of the member stocks have different impacts on the entire index development.²⁴⁴

The arithmetical equal weighting occurs by the investment of identical amounts into the index members at the base time. In contrast to the geometrical allocation the equations depart by different price changes. The price weight²⁴⁵ can not be systematically underestimated. Therefore the disadvantage of the geometrical calculation is not granted.²⁴⁶

2.1.3.3 Market Capitalisation Weighting

The indexation by market cap weights the single members by their respective market values in proportion to the total market and constitutes the central origin of index constructions.²⁴⁷ The calculation of a company's market cap occurs by the multiplication of the current stock price with the number of outstanding shares.²⁴⁸ Frequently containment according to the free tradable stocks is conducted by the free float²⁴⁹ referring to the stocks that are not held by controlling shareholders.²⁵⁰ Expensive rebalancings²⁵¹ are unnecessary because of the automatically adjusted weightings of the index members.²⁵² The intrinsic pro-cyclical characteristic of this indexing approach is conspicuous. By tendency the expensive stocks with increasing market caps are over weighted and the lower priced stocks exhibit a comparatively mean

²⁴¹ Cp. Eberly, Wang (2009), p. 560ff.

²⁴² Cp. Marks, Stuart (1971), p. 300.

²⁴³ Cp. Nelles, Uzik, Holtfort (2007), p. 444.

²⁴⁴ Cp. Cootner (1978), p. 95; Lorie, Hamilton (1978), p. 84f.

²⁴⁵ Cp. Goldberg (2009), p. 31.

²⁴⁶ For exemplary contrasting calculations; cp. Schmitz-Esser (2001), p. 149ff.

²⁴⁷ Cp. Orgland, Leveau (2008), p. 24; Platt, Pope, Rakvin (2004), p. 121.

²⁴⁸ Cp. Amenc, Goltz, Martellini (2011), p. 14.

²⁴⁹ Cp. Lam, Lin, Michayluk (2011), p. 55.

²⁵⁰ Cp. Deutsche Börse AG [ed.] (2008), p. 11; Achleitner, Kaserer, Moldenhauer (2005), p. 123.

²⁵¹ Cp. Willenbrock (2011), p. 43.

²⁵² Cp. Platt, Pope, Rakvin (2004), p. 121.

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